BOOK OF ABSTRACTS

15th Congress of Logic, Methodology and Philosophy of Science
CLMPS 2015

Congress of the Division of Logic, Methodology and Philosophy of Science (DLMPS)

Logic Colloquium 2015
LC 2015

Annual European Summer Meeting of the Association for Symbolic Logic (ASL)

UNIVERSITY OF HELSINKI
3–8 AUGUST 2015

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WORDS OF WELCOME FOR CLMPS 2015

Welcome to the 15th Congress on Logic, Methodology, and Philosophy of Science (CLMPS). The CLMPS is one of the most important activities of the Division of Logic, Methodology and Philosophy of Science (DLMPS) of the International Union for History and Philosophy of Science (IUHPS).

The DLMPS was founded in 1955, and currently has 31 ordinary members (representing countries) and seven international societies as international members. The first Congress took place in Stanford, California in 1960. One of its organizers was Patrick Suppes (1922-2014) who later became President of the DLMPS from 1975-1979; he passed away recently. Given his importance for the Division and our field, it is fitting that there will be a symposium on his work at the Helsinki Congress (Saturday, 8 August, 10am-12pm).

Since that first congress in Stanford in 1960, the CLMPS has been one of the most important global meetings of logicians and philosophers of science, taking place every four years and complementing national and regional meetings that occur more frequently. The Helsinki CLMPS continues this fine tradition. The programme for this Congress, and the abstracts in this volume, show that this Congress will provide a vibrant, probing, and multi-dimensional picture of our research field.

The DLMPS functions as the umbrella organization for logic and philosophy of science at the global level. The DLMPS facilitates discussion of developments in our fields in a number of commissions, some of which are shared with our sister division in the IUHPS, the Division of History of Science and Technology (DHST). In recent years, the two divisions have intensified their collaboration, and this will be visible at the Helsinki Congress in the form of a meeting of the Joint Commission (Friday, 7 August, 2:30pm-7pm; Saturday, 8 August, 10am-11am and 1:30pm-3:30pm), as well as symposia of commissions that are or are planning to be shared between the two divisions: the Teaching Commission, the International Association for Science and Cultural Diversity (IASCUD), and the Commission on History and Philosophy of Computing (HaPoC).

The IUHPS is part of the International Council for Science (ICSU), for which the IUHPS plays a special role by providing a meta-perspective on the scientific enterprise, reflecting on scientific practices and institutions. DLMPS has taken this task seriously at the Helsinki Congress by organizing two special ICSU sessions relating to current global ICSU research projects. One is on “Future Earth and Models of Climate Change”; the other is on “Health and Welfare”. In these sessions, scientists working on these projects will interact with philosophers of science. In 2014 and 2015, IUHPS has coordinated a project for ICSU entitled “Cultures of Mathematical Research Training”; there will be a report on that project as part of the already mentioned meeting of the International Association for Science and Cultural Diversity (IASCUD).

In conclusion we, as representatives of the Executive Committee of DLMPS, want to thank Hannes Leitgeb, who chaired the Program Committee, and Ilkka Niiniluoto, who chaired the Local Organizing Committee, for their excellent work in planning this Congress. They and the members of their committees have worked hard and deserve our gratitude. We also want to thank the scholars who will be giving talks at the Congress. The success of our Congress is now in their hands!

Elliott Sober
President

Benedikt Löwe
Assistant Secretary General

FOREWORD FOR CLMPS 2015

Dear Colleagues,

On behalf of the Local Organising Committee of the 15th Congress of Logic, Methodology, and Philosophy of Science (LMPS), to be held in Helsinki, August 5-10, 2015, I wish all of you welcome to the beautiful capital of Finland.

The great tradition of international congresses of LMPS, under the auspices of the Division of Logic, Methodology and Philosophy of Science, was started in 1960 at Stanford University. Every four years these meetings bring together logicians and philosophers of science from all over the world to present and discuss their current work.

The programme covers all systematic and historical aspects of formal logic, general philosophy of science, and philosophical issues of special sciences. The theme of the 15th Congress is "Models and Modelling". A special feature of the LMPS in 2015 is the co-location of the Logic Colloquium, the European Summer Meeting of the Association for Symbolic Logic (ASL), in Helsinki, which allows the participants also to enjoy a rich supply of lectures in mathematical logic.

The hosting University of Helsinki was established in 1640 as the Royal Academy of Turku. Its staff included a Professor of Theoretical Philosophy whose task was to teach logic or the art of thinking. When the Academy was moved to Helsinki 1828, it adopted the Humboldtian model of research-based education where philosophy played a leading academic role. Modern philosophy of science reached the University a century later, when Eino Kaila as the new Professor of Theoretical Philosophy introduced the principles of logical empiricism. Kaila's students – among them Georg Henrik von Wright, Oiva Ketonen, and Erik Stenius - and von Wright's student Jaakko Hintikka created Helsinki as an important international center of logic and philosophy of science. This philosophical approach was complemented in 1973 by the establishment of a new chair of Mathematical Logic at the Department of Mathematics.

The local organisers of the 15th Congress of LMPS include the Philosophical Society of Finland (founded in 1873 by Professor Thiodolf Rein), and the Finnish Centre of Excellence in the Philosophy of the Social Sciences (TINT).

Helsinki is a lively and safe Northern metropolis that combines smart urban planning with an attractive scenery on the shore of the Baltic Sea (see www.helsinki.fi). In 2014 it placed second in a Financial Times European City ranking. Summertime in Finland provides pleasant sunshine and white nights. The venue of our Congress, the neoclassical main building of the University of Helsinki, is located in the middle of the compact downtown area, within a walking distance from the main hotels.

Welcome to Helsinki in August 2015 to enjoy the blend of logic and philosophy with a friendly intellectual and cultural atmosphere.

Ilkka Niiniluoto
Chair of the Local Organising Committee

PREFACE FOR LC 2015

This volume contains the abstracts of the talks given at the 2015 European Summer Meeting of the Association for Symbolic Logic—Logic Colloquium '15—taking place on August 3 - 8, 2015, in Helsinki, Finland. The Colloquium is co-located with the 15th International Congress of Logic, Methodology and Philosophy of Science, CLMPS, and the SLS Summer School in Logic.

As usual, the talks at the Logic Colloquium consist of invited plenary lectures, invited talks in the various special sessions, tutorials, and, last but not least, contributed papers. Abstracts of all of these presentations are given here. The book of abstracts is an important part of the Logic Colloquium, since it not only gives the authors the opportunity to present their topic and main results, but also helps the Colloquium participants choose which of the many parallel sessions to attend at any given time.

I would like to thank my colleagues in the Program Committee for a very constructive and pleasant period of collaborative effort, which has resulted in, we think, an excellent program of invited speakers, representing current frontline research in the main areas of logic. We are also particularly happy that there are so many contributed papers at this year's Logic Colloquium. Finally, I want to thank all the members of the Organizing Committee, and in particular its chair Jouko Väänänen, for their expert and smooth organization of this important event.

Dag Westerståhl
Program Committee Chair of the Logic Colloquium '15

CLMPS 2015 ORGANIZERS

DIVISION OF LOGIC, METHODOLOGY AND PHILOSOPHY OF SCIENCE (DLMPS) COMMITTEES

EXECUTIVE COMMITTEE OF DLMPS

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Päivi Seppälä (MA, Congress Secretary, University of Helsinki)
Risto Vilkko (Docent, University of Helsinki)
Petri Ylikoski (Professor, University of Helsinki)

Assistantance for local organizing committee:
Ilona Nevalainen, Ilmari Hirvonen, Juho Pääkkönen, Joonas Ottman & Pekka Tolvanen

ORGANIZING INSTITUTIONS AND ACADEMIC SUPPORT

The Philosophical Society of Finland
The Academy of Finland Centre of Excellence in the Philosophy of the Social Sciences (TINT)
Theoretical Philosophy / the Department of Philosophy, History, Culture and Art Studies
The Finnish Society for Science and Technology Studies
Division of Logic, Methdology, and Philosophy of Science (DLMPS)
International Council for Science (ICSU)
University of Helsinki

FINANCIAL SUPPORT

Federation of Finnish Learned Societies
Division of Logic, Methdology, and Philosophy of Science (DLMPS)
Finnish Cultural Foundation
Jenny and Antti Wihuri Foundation
Eino Jutikkala Foundation / Finnish Academy of Science and Letters
University of Helsinki

BOOK EXHIBITION AND CONGRESS MATERIALS

College Publications
The Philosophical Society of Finland / Acta Philosophica Fennica
Oxford University Press
Springer
Bookstore Tiedekirja, Helsinki

SUPPORTING INSTITUTIONS

Helsinki Convention Bureau
City of Helsinki

SPECIAL THANKS

Web page and graphic design team:
Jaakko Kuorikoski, Juho Pääkkönen & Samuli Pöyhönen.

LC 2015 ORGANIZERS

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Jouko Väänänen, University of Helsinki
Andreas Weiermann, Ghent University

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Jouko Väänänen

Members
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Miika Hannula
Lauri Hella
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Tapani Hyttinen
Kaisa Kangas
Juliette Kennedy
Juha Kontinen
Kerkko Luosto
Miguel Moreno
Juha Oikkonen
Gianluca Paolini
Matti Pauna
Fan Yang

Conference secretaries: Päivi Seppälä & Ilona Nevalainen
Web page and graphic design team: Jaakko Kuorikoski, Juho Pääkkönen & Samuli Pöyhönen.

ORGANIZING INSTITUTIONS

The Department of Mathematics and Statistics, University of Helsinki
Association For Symbolic Logic

FINANCIAL SUPPORT

Federation of Finnish Learned Societies
Emil Aaltonen Foundation
Väisälä Foundation / Finnish Academy of Science and Letters
Association For Symbolic Logic

CLMPS 2015 CONGRESS INFO

PREVIOUS CONGRESSES

Starting from 1960 the International Congress of Logic, Methodology and Philosophy of Science has been held every four years in capital cities and/or by famous university centres.

1960 Stanford, California, USA
1964 Jerusalem, Israel
1967 Amsterdam, The Netherlands
1971 Bucharest, Romania
1975 London, Ontario, Canada
1979 Hanover, Federal Republic of Germany
1983 Salzburg, Austria
1987 Moscow, USSR
1991 Uppsala, Sweden
1995 Florence, Italy
1999 Krakow, Poland
2003 Oviedo, Spain
2007 Beijing, China
2011, Nancy France
2015, Helsinki, Finland

CONGRESS VENUE

The congress venue is located in the Main Building of the University of Helsinki (Fabianinkatu 33). You can access the building either from Fabianinkatu (33) or Unioninkatu (the Senate Square side).

Logic Colloquium 2015 is organized in the Porthania Building of the City Center Campus (Yliopistonkatu 3), 50 metres from the Main Building.

FREE ENTRANCE FOR CLMPS 2015 PARTICIPANTS TO LOGIC COLLOQUIUM 2015:

All registered participants of CLMPS 2015 can freely attend to scientific program of Logic Colloquium 2015.

REGISTRATION FEES

The participant registration fee includes:

- Programme attendance and congress materials
- Coffee break refreshments
- Right to participate in the scientific programme of the Logic Colloquium 2015 (August 3-8, Porthania Building)
- The University and City Hall Receptions (a seat at the University Reception can be guaranteed only to the 530 first ones who register online to CLMPS 2015)

NOTE: The congress lunch package and the congress dinner are optional and not included in the congress fee.

The avec fee includes:

The right to attend the social programme as follows:

- Opening Ceremony (Monday at 14.30-16.30)
- University Reception (Monday at 18.30-20.00)
- City Hall Reception (Wednesday at 18.30-20.00)

The congress lunch package and the congress dinner are NOT included in the avec fee, but they may be purchased separately when registering online.

The avec fee does not entitle to participation in the scientific program of CLMPS 2015 or LC 2015.

REGISTRATION AND INFORMATION

You will find the conference registration and information desk on the ground floor of the new side of Main Building (Fabianinkatu 33). If you have registered online for CLMPS 2015, you should come and pick your conference material from the Main Building registration desk before attending any sessions.

The registration desk accepts ONLY CASH PAYMENTS. If you need to pay your registration fee or some other conference services by cash, please bring with you the exact sum.

The registration and information desk will be in your service

Monday : 9:00 – 18:45
Tuesday: 8:45 – 19:15
Wednesday: 8:45 – 19:00
Thursday: 8:45 – 19:15
Friday: 8:45 – 19:15
Saturday: 9:45 – 18:15
Registration desk phone number: +358 44 0612273.

CLMPS 2015: INSTRUCTIONS FOR SPEAKERS

The durations of talks at CLMPS 2015

- Contributed papers: 30 minutes (a 20-minute presentation + a 10-minute discussion)
- Invited lectures: 60 minutes (including discussion)
- Plenary lectures: 90 minutes (including discussion)

Symposium and affiliated meeting organizers can freely decide the duration and format of the talks in their sessions.

All conference rooms are equipped with PC's and projectors to enable a slide show. Whiteboards and flip charts are also available. The congress rooms do not have slide changers so if you wish to use one, remember to bring your own.

The speakers are advised to upload their power point presentations during breaks onto the conference room computers if they wish to use power point

If speakers use their own computers, they are asked to check during the breaks that they can successfully connect the computer to the projector. USB sticks and VGA / HDMI adapters for mac can be rented at the registration desk or from the building managers (if available).

Please note that Prezi presentations can only by shown by using the internet browser of the conference room PCs.

The conference room PCs do not run Skype.

The conference assistants will visit all session rooms before the sessions start and the will help you with downloading your presentation before the session.

CLMPS 2015: INFORMATION FOR CHAIRS

The durations of talks at CLMPS 2015

- Contributed papers: 30 minutes (a 20-minute presentation + a 10-minute discussion)
- Invited lectures: 60 minutes (including discussion)
- Plenary lectures: 90 minutes (including discussion)

CLMPS 2015 CONGRESS INFO

Symposium and affiliated meeting organizers can freely decide the duration and format of the talks in their sessions.

Rules for chairing contributed talk sessions:

1. All contributed papers are allotted 30 minutes in total (20-minute presentation + 10-minute discussion). Please note that few sessions might have open slots, but even for these sessions, presentations should follow the 30-minute format (presentations based on contributed papers should not exceed the maximum time of 30 minutes under any circumstances).

2. The order of presentation within sessions should always follow the order published on http://clmps2015.sched.org. This will allow people to move between papers during sessions and prevents them from missing the presentations they wish to hear.

3. In case of cancellations and no shows that happen on site, the chairs are advised to keep a 30-minute break in place of the cancelled presentation. It is of vital importance that chairs take these breaks so that people who change between sessions do not miss presentations that they wish to hear!

4. For the latest updates to the programme chairs should always check the latest version of CLMPS 2015 Sched in the beginning of the session and take all the breaks marked on Sched. The congress room PCs can be used for this and the conference assistants are happy to help with this. The Sched programme is here: http://clmps2015.sched.org

5. If you are chairing a session in which you are also a speaker, please ask one of the other speakers of the session to chair your presentation when it is your time to present.

6. The conference assistants will visit all session rooms before the sessions start and inform you if there are any cancellations in your session. The assistants will also bring water for the speakers and provide technical assistance. If you encounter any problems during the sessions, please contact the conference assistants, building managers (phone numbers +358 2941 23151 and 358 2941 22338) or registration desk (phone number +358440612273).

7. The speakers are advised to upload their presentations during breaks onto the conference room computers. If speakers use their own computers, they are asked to check during the breaks that they can successfully connect the computer to the projector. USB sticks and VGA / HDMI adapters for mac can be rented at the registration desk (if available).

8. Chairs are kindly asked to remind the members of audience to take all coffee cups and serving plates back to the catering table when they leave the session room. The catering tables are located outside the session rooms.

CLMPS 2015: TECHNICAL ASSISTANCE IN THE CONFERENCE ROOMS

If you encounter any problems during the sessions, please contact the conference assistants, building managers (phone numbers +358 2941 23151 and 358 2941 22338) or registration desk (phone number +358440612273).

LOGIC COLLOQUIUM 2015 INFO

COLLOQUIUM VENUE

The Logic Colloquium 2015 venue is located in the Porthania Building of the University of Helsinki (Yliopistonkatu 3).

The CLMPS 2015 conference venue is located in the Main Building of the University of Helsinki (official address: Fabianinkatu 33). You can access the building either from Fabianinkatu (33) or Unioninkatu 35 (the Senate Square side). Most of the conference rooms are located on the Fabianinkatu side of the building, which is the new wing of the building.

FREE ENTRANCE FOR LOGIC COLLOQUIUM 2015 PARTICIPANTS TO CLMPS 2015

All registered participants of LC 2015 can freely attend to scientific program of CLMPS 2015.

REGISTRATION FEES

The participant registration fee includes:

• Programme attendance and congress materials
• Coffee break refreshments
• Right to participate in the scientific programme of the CLMPS 2015 (August 3-8, University Main Building)
• The University and City Hall Receptions

NOTE: The congress lunch package and the congress dinner are optional and not included in the congress fee.

The avec fee includes:

The right to attend the social programme as follows:

• Opening Ceremony (Monday at 14.30-16.30, Main Building, Great Hall)
• University Reception (Monday at 18.30-20.00, Main Building)
• City Hall Reception (Wednesday at 18.30-20.00)

The congress lunch package and the congress dinner are NOT included in the avec fee, but they may be purchased separately when registering online.

The avec fee does not entitle to participation in the scientific program of CLMPS 2015 or LC 2015.

REGISTRATION AND INFORMATION

You will find the conference registration and information desk on the ground floor of the new side of Main Building (Fabianinkatu 33). If you have registered online for LC 2015, you should come and pick your conference material from the Porthania registration desk.

The registration desk accepts ONLY CASH PAYMENTS. If you need to pay your registration fee or some other conference services by cash, please bring with you the exact sum.

The registration and information desk will be in your service

Monday :	8:30 – 17:00
Tuesday:	8:45 – 18:15
Wednesday:	8:45 – 18:30
Thursday:	8:45 – 14:30
Friday:	8:45 – 18:15
Saturday:	8:45 – 16:00

Registration desk phone number: +358 50 5268764.

LC 2015: INSTRUCTIONS FOR SPEAKERS

The durations of talks at LC 2015

- Contributed talks: 20 minutes (incl. discussion)
- Plenary and tutorial lectures: 60 minutes (including discussion)
- Special session lectures: 45 minutes (including discussion)

All conference rooms are equipped with PC's and projectors to enable a slide show. Whiteboards and flip charts are also available. The congress rooms do not have slide changers so if you wish to use one, remember to bring your own.

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2. The order of presentation within sessions should always follow the order published on the congress program. This will allow people to move between papers during sessions and prevents them from missing the presentations they wish to hear.
3. **In case of cancellations and no shows that happen on site, the chairs are advised to keep a 30-minute break in place of the cancelled presentation.** It is of vital importance that chairs take these breaks so that people who change between sessions do not miss presentations that they wish to hear!
4. If you are chairing a session in which you are also a speaker, please ask one of the other speakers of the session to chair your presentation when it is your time to present.
5. The conference assistants will visit all session rooms before the sessions start and inform you if there are any cancellations in your session. The assistants will also bring water for the speakers and provide technical assistance. If you encounter any problems during the sessions, please contact the conference assistants, building managers (phone number +358 2941 22561) or registration desk (phone number +358 50 5268764).
6. The speakers are advised to upload their presentations during breaks onto the conference room computers. If speakers use their own computers, they are asked to check during the breaks that they can successfully connect the computer to the projector. USB sticks and VGA / HDMI adapters for mac can be rented at the registration desk (if available).
7. Chairs are kindly asked to remind the members of audience to take all coffee cups and serving plates back to the catering table when they leave the session room. The catering tables are located outside the session rooms.

LC 2015: TECHNICAL ASSISTANCE IN THE CONFERENCE ROOMS

If you encounter any problems during the sessions, please contact the conference assistants, building managers (phone number +358 2941 22561) or registration desk (phone number +358 50 5268764).

CLMPS 2015 & LC 2015 PRACTICAL INFORMATION

CONFERENCE VENUES

The CLMPS 2015 conference venue is located in the Main Building of the University of Helsinki (official address: Fabianinkatu 33). You can access the building either from Fabianinkatu (33) or Unioninkatu 35 (the Senate Square side). Most of the conference rooms are located on the Fabianinkatu side of the building, which is the new wing of the building.

The Logic Colloquium 2015 venue is located in the Porthania Building of the University of Helsinki (Yliopistonkatu 3).

Porthania Building and the University Main Building are located 50 meters from one another, which means that participants CLMPS 2015 and LC 2015 can easily change from one building to another.

CLMPS 2015 REGISTRATION AND INFORMATION

You will find the conference registration and information desk on the ground floor of the new side of Main Building (Fabianinkatu 33). If you have registered online for CLMPS 2015, you should come and pick your conference material from the Main Building registration desk before attending any sessions.

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Friday:	8:45 – 19:15
Saturday:	9:45 – 18:15

Registration desk phone number: +358 44 0612273.

LC 2015 REGISTRATION AND INFORMATION

You will find the conference registration and information desk on the ground floor of the new side of Main Building (Fabianinkatu 33). If you have registered online for LC 2015, you should come and pick your conference material from the Porthania registration desk before attending any sessions.

The registration desk accepts ONLY CASH PAYMENTS. If you need to pay your registration fee or some other conference services by cash, please bring with you the exact sum.

The registration and information desk will be in your service

Monday :	8:30 – 17:00
Tuesday:	8:45 – 18:15
Wednesday:	8:45 – 18:30
Thursday:	8:45 – 14:30
Friday:	8:45 – 18:15
Saturday:	8:45 – 16:00

Registration desk phone number: +358 50 5268764.

ACCESSIBILITY

All conference rooms in Porthania are wheel chair accessible. All conference rooms in the Main Buiding besides rooms 14 and 15 are wheel chair accessible.

The wheel chair entrance of the Main building is located on the new side of the builiding (address: Fabianinkatu 33).

INTERNET

1. If you have downloaded **Eduroam** on your computer and your home university uses Eduroam, you connect to University of Helsinki Eduroam network with the internet username and password of your home institution.

2. The University WLAN (**HUPnet**) is free of charge. You need a username and a password in order to log in. You can find your temporary username and password in your conference material envelope. Please save the username and password throughout the conference.

Your laptop should automatically find the University HUPnet when you are inside the Main Building or Porthania. Just select the "Univ Helsinki HUPnet" from the list of available wireless networks and the log in -page should automatically open.

3. Conference participants can freely use the computers of the conference rooms to access internet during the conference when sessions are not running. The conference room PC's do not require any passwords.

SOCIAL MEDIA

The social media hashtag for the congresses ar #clmps2015 and #lc2015.

The facebook group "CLMPS / LC 2015" is meant for the conference participants to organize their own unofficial collegial meetings before, during and after the conference days. The facebook group can also be used to present questions to the local organizing committee and to share conference photos and useful links.

LUGGAGE ROOM AND COAT CHECK

CLMPS 2015: You can leave your luggage in room 11 on Saturday (2nd floor of the Main Building). The room will not be locked. There are also lockers meant for backpacks and smaller items on the ground floor of the Main Building (New side). The congress will not assume any liability for lost property during the conference.

LC 2015: There is an unattended coat check on the ground floor of Porthania where participants can leave their luggage during the conference days. LC 2015 will not assume any liability for lost property during the conference.

PRINTING

The nearest print shop Unigrafia is located 50 metres from Porthania building, address Vuorikatu 3. Unigrafia is open 8.30-16.00 (Monday-Friday).

Please note that the congress registration desk can only print a few pages of essential material for you (e.g. boarding passes). For printing out presentation slides, articles or hand-outs, please contact Unigrafia.

LUNCHES

FOR THOSE WHO HAVE PURCHASED THE LUNCH PACKAGE:

The University restaurant Main Building will prepare a special on-site congress lunches for the participants of the CLMPS and Logic Colloquium 2015 congresses (address: Fabianinkatu 33, ground floor). The price of the special on-site lunch package is 60,60 € (incl. 6 Buffet lunches from Monday to Saturday. Fish, meat, vegetarian, and salad options are available every day). Ask at the registration desk if you wish to purchase this package on site.

FOR THOSE WHO WANT TO ARRANGE THEIR OWN LUNCHES:

There are hundreds of restaurants within a few minutes walk from the conference site which is located in the heart of the city.

Please see http://eat.fi for all restaurants in town.

Here is a selection of good lunch places next to the Main Building:

- Restaurant Sunn (modern Finnish and international cuisine), Aleksanterinkatu 26
- Base Camp (Nepalese cuisine), Yliopistonkatu 5
- Neuvo (Spanish cuisine), Sofiankatu 4
- Restaurant Aino (Finnish cuisine), Pohjoisesplanadi 21
- Sushi Bar Rice Garden, Kaisaniemenkatu 2
- Restaurant Maya Bar & Grill (texmex), Mikonkatu 18

COFFEE AND REFRESHMENTS

Coffee and tea will be served during the coffee breaks marked on the conference program.

If you wish to have coffee at some other time, please check out these options within a walking distance:

- Karl Fazer Café, Kluuvikatu 3
- Café Engel, Aleksanterinkatu 26
- Espresso Edge, Liisankatu 29
- Ciao Café, Aleksanterinkatu 28
- Torrefazione Fratello, Yliopistonkatu 6
- Café Neuhaus, Unioninkatu 32
- Gran Delicato Galleria Esplanad, Kämp Gallery, Pohjoisesplanadi 29

The University café on the ground floor of the Main building (new side) is open on Monday, Tuesday Wednesday, Thursday, and Friday (8:30 – 15:30).

DINNER RESTAURANTS

There are many nice restaurants in the city centre close to the Main Building. In these restaurants you can have both lunch and dinner:

- Restaurant Aino, Pohjoisesplandi 21
- Belge Bar & Bistro, Kluuvikatu 5
- Sasso, Pohjoisesplanadi 17

- Kappeli, Eteläesplanadi 1
- Il Siciliano, Aleksanterinkatu 36
- Restaurant Sunn, Aleksanterinkatu 26

You can find more restaurants at http://eat.fi

ATM

The nearest ATM is located on Aleksanterinkatu 30 inside the Nordea Bank head office. The Nordea head office is opposite to the University main building on Aleksanterinkatu. There are also several other ATM's on Aleksanterinkatu.

There are also ATM's on the corner of Yliopistonkatu and Mikonkatu.

SHOPPING

Most department stores and shopping centres are open Monday-Friday 9:00-21:00, on Saturday 9:00-18:00, and on Sunday 12:00-18:00.

TOURIST INFORMATION

The tourist information point is located on Pohjoisesplanadi 19. See also www.visithelsinki.fi.

POLICE AND MEDICAL ASSISTANCE

If you need to call the police or need an ambulance, the emergency number is: **112**.

TAXI

Dial 0100 0700 to call a taxi. Taxis are rather expensive but safe. Taxis accept all major credit cards. Taxis can also be hailed (if the taxi light is on).

ARRIVING IN HELSINKI

By plane: Helsinki-Vantaa airport.

Connections to the city center (railway station) from the airport:

- Taxi (40-50 €)
- Finnair City Bus (6-7 €),
- Public Transport Bus (c. 5 €),
- NEW Train Connection "Ring Trail Line" will be opened in July 2015 from the airport to the city center! (c. 5 €)

Helsinki is also easily reached by high-class ferries from Stockholm (overnight trips) and from Tallinn (several ferries, duration 1.5 to 3.5 hours). There is also a direct train connection to St. Petersburg (4 hours).

TRANSPORTATION IN HELSINKI

You can find information about timetables and routes of public transport at the Helsinki Journey Planner. (www.hsl.fi)

There are numerous taxi stands around the city centre. To order a taxi, you can call +358 100 0700 at any time (more information at www.taksihelsinki.fi). Taxis can also be hailed (if the taxi light is on).

WEATHER

The average day temperature is around 18 °C in Helsinki in early August. There might be occasional rain showers, and in the night the temperature might drop down to 10 °C, so remember to take some warm clothes and an umbrella with you.

CLMPS

CLMPS 2015 PROGRAMME

MONDAY 3 AUGUST

9:00AM-2:30PM

Registration

You will find the conference registration and information desk on the ground floor of the new side of Main Building (Fabianinkatu 33). If you have registered online for CLMPS 2015, you should come and pick your conference material from the Main Building registration desk before attending any sessions.

On-site registration is also possible at any time during the congress.

The registration desk accepts ONLY CASH PAYMENTS. If you need to pay your registration fee or some other conference services by cash, please bring with you the exact sum.

Venue - Main Building Lobby

12:00PM-1:00PM

Special session on CLMPS 2015 conference theme: Models and Modelling

Special Sessions

Chair:
Elliott Sober, University of Wisconsin - Madison

Confirmation Theory for Idealized Models
Michael Weisberg
University of Pennsylvania, USA

Venue - Main Building, Room 1

1:00PM-2:30PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with LC 2015) for participants who have purchased the additional lunch package (60,60 €).

Venue - Main Building Unicafe

2:30PM-4:30PM

Opening for CLMPS 2015 and LC2015

Social Events

The opening ceremony is also open for avecs! The program includes welcome addresses by CLMPS 2015 and LC 2015 organizers and organizing institutions. The Classic University Choir, YL double quartet, will perform best pieces of their reportoire.

Venue - Main Building Great Hall

4:30PM-5:00PM

Coffee

Venue - Main Building, Teachers' Lounge

5:00PM-6:30PM

Plenary Lecture: Johan van Benthem

Plenary Lectures

Chair
Ilkka Niiniluoto, University of Helsinki

Logic in Play
Johan van Benthem
Amsterdam, Stanford, and Tsinghua University

Venue - Main Building Great Hall

6:30PM-8:00PM

University Reception

Social Events

The University of Helsinki welcomes the congress participants by treating them to a wine and salad buffet after the first congress-opening day. NOTE: The number of participants at the University Reception is limited. The earlier you register for CLMPS 2015, the more likely you will get the right to participate in the University Reception (by choosing the participation on the registration form). The reception is also open for avecs!

Venue - Main Building, Teachers' Lounge

TUESDAY 4 AUGUST

9:00AM-10:30AM

Plenary Lecture: Rachel Ankeny
Plenary Lectures

Chair
Gerhard Heinzmann, Université de Lorraine

Repertoires: How to Transform a Project into a Research Community
Rachel A. Ankeny
University of Adelaide, AUSTRALIA
Sabina Leonelli
University of Exeter, UNITED KINDOM

Venue - Main Building, Room 1

9:00AM-10:30AM

Logical, Modelling and Philosophical Foundations of Science - Historical Development, Current Investigations and Perspectives I
Affiliated Meetings

Organized by
Boris Chendov, independent scholar
Peeter Müürsepp, Tallinn University of Technology
Arto Mutanen, Finnish National Defence University

Abstract structures of logistic as a complex theory unifying methodology of S-modelling and logic of science – research programme
Boris Chendov
independent scholar

An extension of EVIDENCE LOGIC: providing a foundational framework for mathematical epistemology
Don Faust
Northern Michigan University

Venue - Main Building, Auditorium IV

9:00AM-10:30AM

The Legacy of Joachim Lambek (FoLLI affiliated meeting) I
Affiliated Meetings

Organized by
Michael Moortgat, Utrecht University
Philip Scott, University of Ottawa

Lambek's proof theory (45 min)
Kosta Dosen
Mathematical Institute, Serbian Academy of Sciences and Arts
Stack representation for pretopoi: Towards logical schemes (45 min)
Steve Awodey
Carnegie Mellon University

Venue - Main Building, Room 3

9:20AM-10:30AM

Let's act! - Formal models of collective agency, intention, and responsibility I
Affiliated Meetings

Organized by
Frederik Van De Putte, Ghent University

Collective obligations, group plans, and individual actions
Hein Duijf
University of Utrecht (REINS Project), NETHERLANDS
Allard Tamminga
University of Utrecht and University of Groningen, NETHERLANDS

Venue - Main Building, Room 5

10:30AM-11:00AM

Coffee

Venue - Main Building, new side

11:00AM-1:00PM

A3. Invited Session: Computational Logic and Applications of Logic
Invited Sessions

Chair
Yoram Moses, Israel Institute of Technology

Syntactic Epistemic Logic
Sergei Artemov , City University of New York, USA

A Logical Revolution
Moshe Y. Vardi , Rice University, USA

Venue - Main Building, Small Hall

11:00AM-1:00PM

B4. Invited Session: Ethical and Political Issues in the Philosophy of Science
Invited Sessions

Chair
Tetsuji Iseda, Kyoto University

Rationality at the science-policy interface
Sven Ove Hansson
KTH Royal Institute of Technology, Stockholm, SWEDEN

Biodiversity and Bio-patenting: Constructive Challenges of Scientific Research
Sang-Wook Yi
Department of Philosophy, Hanyang University, Seoul, SOUTH KOREA

Venue - Main Building, Room 1

11:00AM-1:00PM

Let's act! - Formal models of collective agency, intention, and responsibility II
Affiliated Meetings

Organized by
Frederik Van De Putte, Ghent University

Some forms of collectively seeing to it that (11.00-12.00)
Marek Sergot
Imperial College, London

Group agents – do they make sense? (**12.00-13.00)**
Gillman Payette
University of British Columbia

Venue - Main Building, Room 5

11:00AM-1:00PM

Logical, Modelling and Philosophical Foundations of Science - Historical Development, Current Investigations and Perspectives II
Affiliated Meetings

Organized by
Boris Chendov, independent scholar
Peeter Müürsepp, Tallinn University of Technology
Arto Mutanen, Finnish National Defence University

About Scientific Explanation
Arto Mutanen
Finnish National Defence University

Interrogative Model of Explanation: New Perspectives
Ilpo Halonen
University of Helsinki

About Syntactic Representation of Logical Matrix
Sergey A. Pavlov
Institute of Philosophy at the RAS

Methodological reflections on non-standard logics, their relations to empirical sciences, and Tarski's notion of 'semantically complete' language
Koji KN Nakatogawa
Hokkaido University

Venue - Main Building, Auditorium IV

11:00AM-1:00PM

The Legacy of Joachim Lambek (FoLLI affiliated meeting) II
Affiliated Meetings

Organized by
Michael Moortgat, Utrecht University
Philip Scott, University of Ottawa

Monoidal Turing Categories and Linear Combinatory Algebras
Robin Cocket
University of Calgary

On syntactic interpretations in Full Lambek Calculus
Wojciech Buszkowski
Adam Mickiewicz University, Poznan

Algebraic Foundations and the work of J. Lambek
Philip Scott
University of Ottawa

Venue - Main Building, Room 3

11:00AM-1:00PM

Session of IASCUD (International Association for Science and Cultural Diversity) I
Commission Sessions

Organizer
Kenji Ito, President IASCUD

The role of (visual) representations in mathematics
Jessica Carter
University of Southern Denmark, Odense, DENMARK

An appraisal of presenting mathematics in metrical form from a socio-cultural perspective
Krishnamurthi Ramasubramanian
Indian Institute of Technology, Bombay, INDIA

On the project 'Culture of Mathematical Research Training'
Benedikt Löwe
Universiteit van Amsterdam, The Netherlands & Universität Hamburg, GERMANY; University of Cambridge, ENGLAND; Assessor of IASCUD

Venue - Main Building, Room 7

11:00AM-1:00PM

A2.1 Philosophical Logic
Contributed Papers

Chair
Gabriel Sandu, University of Helsinki

Deflationism and Conservativity
Aaron Thomas-Bolduc
Philosophy, University of Calgary, Calgary, CANADA

Deflationism and the meaning of Gödel's sentence
Aleksandr Khlebalin
Logic and Epistemology, Institute of philosophy and law of Siberian branch, Novosibirsk, RUSSIAN FEDERATION

Motivations for alethic pluralism
Andy Yu
Philosophy, Oxford University, Oxford, UNITED KINGDOM

On the simplicity of truth
Giulia Terzian
Philosophy, University of Bristol, Bristol, UNITED KINGDOM

Venue - Main Building, Room 8

11:00AM-1:00PM

A4.1 Historical Aspects of Logic / Ancient logic
Contributed Papers

Chair
Heidi White, New York University

Why Does Formal Deductive Logic Start With the Classical Greeks?
Michael Shenefelt
Liberal Studies, New York University, USA
Heidi White
New York University, USA

Dialectical Games and the Origin of Logic
Mathieu Marion
Philosophie, Universié du Québec à Montréal, Montréal, QC, CANADA

Negation and truth in Greek mathematics and philosophy
Ioannis Vandoulakis, School of Humanities
The Hellenic Open University, Athens, GREECE

Redundancy and the Stoic Themata
John Woods
Philosophy, Bilkent University, Bilkent, Ankara, TURKEY

Venue - Main Building, Room 17

11:00AM-1:00PM

B1.1 Methodology
Contributed Papers

Chair
Tero Ijäs, University of Helsinki

Definitions: Eliminability and Conservativeness
Marian Zouhar
Department of Logic and Methodology of Sciences, Faculty of Philosophy, Comenius University, Bratislava, SLOVAKIA

Contexts for philosophy: How can novel contexts in synthetic biology help philosophy of science?
Petri Turunen
Department of Political and Economic studies, University of Helsinki, HELSINKI, FINLAND
Tero Ijäs
Department of Political and Economic studies, University of Helsinki, HELSINKI, FINLAND

A Hessian Approach to Analogical Reasoning in Theory Construction
Ruey-Lin Chen
Philosophy, National Chung Cheng University, Chia-Yi, TAIWAN
Jean-Sebastien Bolduc
Laboratoire de Biométrie et Biologie Evolutive, Université Claude Bernard Lyon 1, Lyon, FRANCE

A Frame-Based Approach for Operationalized Concepts
Stephan Kornmesser
Institute of Philosophy, University of Oldenburg, Oldenburg, GERMANY

Venue - Main Building, Room 13

11:00AM-1:00PM

B2.1 Formal Philosophy of Science and Formal Epistemology
Contributed Papers

Chair
Michael Schippers, University of Oldenburg

Nagelian reduction and coherence
Philippe van Basshuysen
Philosophy, LSE, London, UNITED KINGDOM

Coherentism, pluralism and the problem of measure sensitivity
Michael Schippers
Department of Philosophy, University of Oldenburg, Oldenburg, GERMANY

Carnap's Relevance Measure as Probabilistic Measure of Coherence
Jakob Koscholke
Philosophy Department, University of Oldenburg, Oldenburg, GERMANY

Venue - Main Building, Room 15

11:00AM-1:00PM

B3.3 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Elizabeth Martínez-Bautista, IIF-UNAM

Modal Epistemology and Scientific Classifications: Evolutionary Scenarios as Possible Worlds and Bayesian Inference
Elizabeth Martínez-Bautista
Philosophy of Science, IIF-UNAM, Mexico DF, MEXICO

Counterfactuals, Observability, and Modal Metaphysics: a response to Ladyman
Sergio Gallegos
Philosophy, MSU Denver, Denver, CO, USA

Grounds and Structures. A Discussion on a Possible Metaphysical Framework
Bianca Savu
Theoretical Philosophy and Logic, University of Bucharest, Faculty of Philosophy, Bucharest, ROMANIA

Antique atomism, modern physics and structural realism
Elena Mamchur
Philosophical Issues in Natural Science, Institute of Philosophy RAS, Moscow, RUSSIAN FEDERATION

Venue - Main Building, Room 12

11:00AM-1:00PM

C1.1 Philosophy of the Formal Sciences
Contributed Papers

Chair
Susan Vineberg, Wayne State University

Penelope Maddy between realism and naturalism
Ladislav Kvasz
Institute of Philosophy, Academy of Sciences , Prague, CZECH REPUBLIC

The Subject of Mathematics
Elzbieta Kaluszynska
Instytut Filozofii i Socjologii, Polish Academy of Science, Swietajno, POLAND

Why believe there are infinite sets?
Andrei Marasoiu
Philosophy, University of Virginia, Charlottesville, VA, USA

Is There an Objective Account of Mathematical Depth?
Susan Vineberg
Philosophy, Wayne State University, Detroit, USA

Venue - Main Building, Room 10

11:00AM-1:00PM

C2.1 Philosophy of the Physical Sciences
Contributed Papers

Chair
Vincent Ardourel, University Lille 1

Einsten's Criticism of Quantum Mechanics and Humean Philosophy
Morita Kunihisa
Faculty of Arts and Science, Kyushu University, Fukuoka, JAPAN

A Discrete Solution for the Paradox of Achilles and the Tortoise
Vincent Ardourel
History of Physics, University Lille 1, Villeneuve-d'Ascq, FRANCE

Measurement in Berkeley's philosophy
Ozaki Yuki
Graduate school of science, Hokkaido university, Sapporo, JAPAN

Venue - Main Building, Room 6

11:00AM-1:00PM

C3.1 Philosophy of the Life Sciences
Contributed Papers

Chair
Elselijn Kingma, Eindhoven

Evolutionary explanations
Susanne Hiekel
Insitute for philosophy, University Duisburg-Essen, Essen, GERMANY

The plant and the pollinator tale: or how to take teleology seriously and yet not be a Lamarkian?
Iñigo Ongay de Felipe
Fundación Gustavo Bueno., Fundación Gustavo Bueno, Oviedo, SPAIN

Explanatory unification and statistical interpretations of natural selection and drift
Stefan Petkov
Institute of Science, Technology and Society, Tsinghua University, Beijing, CHINA

Functions at the interface of biology and technology: synthetic biology, cultivated biology and coevolution
Elselijn Kingma
Philosophy & Ethics, Eindhoven, Eindhoven, NETHERLANDS

Venue - Main Building, Room 4

11:00AM-1:00PM

C4.1 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
Leone Montagnini, Librarian Metropolitan System of Rome

In virtue of what do personality traits explain?
Lilia Gurova
Cognitive Science and Psychology, New Bulgarian University, Sofia, BULGARIA

Integrating and unifying cognitive science using mechanisms
Marcin Milkowski
Section of Logic and Cognitive Science, Institute of Philosophy and Sociology PAS, Warszawa, POLAND

Some Theoretical and Metatheoretical Issues in Computer Brain-inspired Projects: reflecting on Early Cybernetics looking to the present Neocybernetic projects
Leone Montagnini
Manager of the Office for Scientific Culture, Librarian Metropolitan System of Rome, ROME, ITALY

Venue - Main Building, Room 14

11:00AM-1:00PM

C5.1 Philosophy of the Humanities and the Social Sciences + C6.4 Philosophy of the Applied Sciences and Technology
Contributed Papers

Chair
Robert Northcott, Birkbeck College

What explains economics imperialism?
Robert Northcott
Philosophy, Birkbeck College, London, UNITED KINGDOM

A Defense of Equilibrium Methods in Economics
Jennifer Jhun
Philosophy, University of Pittsburgh, Pittsburgh, USA

How and Why Models Are Not Experiments – Epistemological Trouble in Economic Science
Olga Koshovets
Philosophy and Methodology of Economics, Russian Academy of Sciences` Institute of Economic, Moscow, RUSSIAN FEDERATION

Philosophical Problems of Information and Network Societies
Naira Danielyan
Philosophy and Sociology, National Research University of Electronic Technol, Moscow, RUSSIAN FEDERATION

Venue - Main Building, Room 16

11:00AM-1:00PM

Truth and Paradox: wither the future?
Symposia

Necessities and Necessary Truths Revisited
Volker Halbach
University of Oxford

Definability of Truth and Intensional Context
Dora Achourioti
University of Amsterdam

Disquotation and Deflationism
Thomas Schindler
MCMP and Lavinia Picollo, University of Buenos Aires

Reflection, Truth, Entitlement
Leon Horsten
University of Bristol

Venue - Main Building, Auditorium II

1:00PM-2:30PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with LC 2015) for participants who have purchased the additional lunch package (60,60 €).

Venue - Main Building Unicafe

2:30PM-4:30PM

International Council for Science (ICSU) special session: Health and Wellbeing in the Changing Urban Environment

Special Sessions

Chair
Peter Schoeder-Heister, University of Tuebingen

Health and Well Being in the Changing Urban Environment – An interdisciplinary program of the International Council for Science (ICSU)
Dov Jaron
Drexel University, USA ICSU, FRANCE

Well-being and Health: A Perspective from Philosophy of Science
Anna Alexandrova
University of Cambridge, UNITED KINGDOM

Venue - Main Building, Small Hall

2:30PM-4:30PM

Let's act! - Formal models of collective agency, intention, and responsibility III

Affiliated Meetings

Organized by
Frederik Van De Putte
Ghent University

A logical analysis of responsibility attribution: emotions, individuals and collectives (14:30 – 15:30)
Emiliano Lorini
Centre National de la Recherche Scientifique, Toulouse

Objectivity versus subjectivity and contribution versus avoidance in a formal theory of shared responsibility 15:30 – 16:30
Jan Broersen
University of Utrecht

Venue - Main Building, Room 5

2:30PM-4:30PM

Logical, Modelling and Philosophical Foundations of Science - Historical Development, Current Investigations and Perspectives III

Affiliated Meetings

Organized by
Boris Chendov, independent scholar
Peeter Müürsepp, Tallinn University of Technology
Arto Mutanen, Finnish National Defence University

Which Empiricism – Standard or Aim-Oriented?
Peeter Müürsepp
Tallinn University of Technology

On the Limits of Knowledge
Enn Kasak
University of Tartu

A Contextual View of Science
Sumei Cheng
Shanghai Academy of Social Sciences

Is the Third Wave of Science Studies Coming? : Comment on Harry Collins' Philosophy of Expertise
Zhang Fan
Shanghai Academy of Social Sciences

Venue - Main Building, Auditorium IV

2:30PM-4:30PM

The Legacy of Joachim Lambek (FoLLI affiliated meeting) III

Affiliated Meetings

Organized by
Michael Moortgat, Utrecht University
Philip Scott, University of Ottawa

Quantum theory ⊥ grammar = Lambek
Bob Coecke
University of Oxford

Quantifiers and scope in pregroup grammar
Claudia Casadio
University of Chieti

Linear algebraic semantics for natural language through Lambek's pregroups
Mehrnoosh Sadrzadeh
Queen Mary University of London

Venue - Main Building, Room 3

2:30PM-4:30PM

Session of IASCUD - Science and Cultural Diversity: Integrating Historical and Philosophical Aspects II

Commission Sessions

Organized by
Kenji Ito, President IASCUD

Science and cultural diversity: the problem of Orientalism
Kenji Ito
The Graduate University for Advanced Studies, Hayama, JAPAN; President of IASCUD

Same ascriptions, different methods?
Smita Sirker
Jadavpur University, Kolkata, INDIA

Venue - Main Building, Room 7

2:30PM-4:30PM

A2.2 Philosophical Logic

Contributed Papers

Chair
Brice Halimi, University Paris Ouest

Towards a Non-Fregean Axiomatic Theory of Truth
Joanna Golinska-Pilarek
Institute of Philosophy, University of Warsaw, Warsaw, POLAND
Taneli Huuskonen
University of Helsinki, Department of Mathematics , Helsinki, FINLAND

Homotopy Model Theory
Brice Halimi
Philosophy, University Paris Ouest, Nanterre, FRANCE

Epistemic Truth-Values
Fabien Schang
Philosophy, National Research University, HSE, Moscow, Moscow, RUSSIAN FEDERATION

An assumption-based logic for the analysis of inconsistent premises
Jesse Heyninck
Institute for Philosophy II, Ruhr-University Bochum, Bochum, GERMANY
Christian Straßer
Institute for Philosophy II, Ruhr-University Bochum, Bochum, GERMANY

Venue - Main Building, Room 8

2:30PM-4:30PM

A2.3 Philosophical Logic

Contributed Papers

Chair
Jiji Zhang, Lingnan University

A Lattice of Fundamental Four-Valued Modal Logics
Alexander Karpenko
Logic, Institute of Philosophy of RAS, Moscow, RUSSIAN FEDERATION

Reflexive insensitive modal logics
David Gilbert
Philosophy, State University of Campinas, Campinas, BRAZIL Giorgio Venturi, State University of Campinas, Campinas, BRAZIL

Causal Models, Conditional Logic, and Cycles of Counterfactual Dependence
Jiji Zhang
Philosophy, Lingnan University, Hong Kong, HONGKONG
Wai-Yin Lam
HKU SPACE Community College, Hong Kong, HONGKONG

The Curious Status of the Principle of Conditional Non-Contradiction
Matthias Unterhuber
Department of Philosophy, University of Bern, Bern, SWITZERLAND

Venue - Main Building, Room 13

2:30PM-4:30PM

B1.2 Methodology
Contributed Papers

Chair
Collier John, University of KwaZulu-Natal

The Challenges of Incommensurability to Comparative Philosophy
Xinli Wang
Philosophy, Juniata College, HUNTINGDON, USA

Kuhnian Turn in Scientific Rationality
In-Rae Cho
Philosophy, Seoul National University, Seoul, SOUTH KOREA

Progress across revolutionary change in science
Collier John
Philosophy, University of KwaZulu-Natal, Durban, SOUTH AFRICA

Why the Function of Concepts Matters
Hyundeuk Cheon
Institute for the Humanities, Ewha Womans University, Seoul, SOUTH KOREA

Venue - Main Building, Room 17

2:30PM-4:30PM

B2.2 Formal Philosophy of Science and Formal Epistemology
Contributed Papers

Chair
Christopher Hitchcock, California Institute of Technology

Intervention and Decision
Christopher Hitchcock
Division of Humanities and Social Sciences, California Institute of Technology, Pasadena, USA

Causality as a theoretical concept, intervention assumptions, and empirical content
Alexander Gebharter
DCLPS, University of Duesseldorf, Duesseldorf, GERMANY Gerhard Schurz, DCLPS, University of Duesseldorf, Duesseldorf, GERMANY

Constructing Causal Variables
Frederick Eberhardt
Humanities, Caltech, Pasadena, USA

A Principled Approach to Defining Actual Causation
Sander Beckers
Computer Science, KULeuven, Leuven, BELGIUM
Joost Vennekens, KULeuven, Leuven, BELGIUM

Venue - Main Building, Room 14

2:30PM-4:30PM

B3.1 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Matt Farr, University of Queensland

Omissions as Causes
Gerald Vision
Philosophy, Temple University, Philadelphia, USA

The Inference to the Most Invariant Cause
Xavi Lanao
Philosophy, University of Notre Dame, Notre Dame, IN, USA

Causation and Time Reversal
Matt Farr
Philosophy, University of Queensland, Brisbane, AUSTRALIA

Reichenbachian Common Cause Systems Compared
Chrysovalantis Stergiou
Department of Humanities, Social Sciences, and Law, National Technical University of Athens, Zografou-Athens, GREECE

Venue - Main Building, Room 12

2:30PM-4:30PM

B5.3 Historical Aspects in the Philosophy of Science
Contributed Papers

Chair
Sami Pihlström, Helsinki Collegium for Advanced Studies

On Pierre Duhem's Two Epistemologies, "high" & "low"
Horia-Roman Patapievici
Philosophy, University of Bucharest, Bucharest, ROMANIA

Thomas Kuhn's Changing Conception of the External World
Erkan Bozkurt, Philosophy
Ege University, Izmir, TURKEY

The Dynamic, Relative or Pragmatic A Priori: How philosophers of science have used constitutive elements of science to model conceptual change
David Stump
Philosophy, University of San Francisco, San Francisco, USA

PRAGMATIC REALISM, IDEALISM, AND PLURALISM: A RESCHERIAN BALANCE?
Sami Pihlström
Helsinki Collegium for Advanced Studies, University of Helsinki, University of Helsinki, FINLAND

Venue - Main Building, auditorium I

2:30PM-4:30PM

C2.2 Philosophy of the Physical Sciences
Contributed Papers

Chair
Corey Sawkins, University of Guelph

A Defense of Non-causal Explanations in Relativity
Corey Sawkins
Philosophy, University of Guelph, Guelph, CANADA

Hawking and Penrose: The Reality Debate
Wojciech Grygiel
Philosophy, The Pontifical University of John Paul II, Kraków, POLAND

Interpretation and Ontology in Special Relativity
Kevin Coffey
Philosophy, NYU Abu Dhabi, New York, USA

Only Point-Coincidences. Erich Kretschman, the Point-Coincidence Argument and the Emergence of Logical Empiricist Interpretation of General Relativity
Marco Giovanelli
Philosophy, Universität Tübingen, Tübingen, GERMANY

Venue - Main Building, Room 6

2:30PM-4:30PM

C7.2 Philosophy of Medicine
Contributed Papers

Chair
Gulen Addis, Buckinghamshire New University

Presumption and Prejudice in Diagnostics
Stephanie Van Droogenbroeck
Centre for Logic and Philosophy of Science, Vrije Universiteit Brussel, Brussels, BELGIUM

The preference toward identified victims in medical decision making
Tomasz Zuradzki
Institute of Philosophy, Jagiellonian University, Kraków, POLAND

Evidence Based Practice and Expert Judgement in Nursing
Gulen Addis
Faculty of Society and Health, Buckinghamshire New University, London, UNITED KINGDOM

An Alternative to the Placebo Concept in Psychotherapy
Sydney Katherine Green
Center for Logic and Analytical Philosophy, KU Leuven, Leuven, BELGIUM

Venue - Main Building, Room 4

2:30PM-4:30PM

Ratio ad contrarium: the logical and philosophical importance of reasoning under contradictions
Symposia

Probability measures of the inconsistent– and of the contradictory
Walter Carnielli
State University of Campinas –UNICAMP

Paraconsistency as evidence preservation: a natural deduction approach
Abilio Rodrigues
Federal University of Minas Gerais

Der Läufer darf gerade ziehen und der Läufer darf nicht gerade ziehen? Sketches for an anthropological philosophy of paraconsistency, based on the notion of rules
Marcos Silva
University of Ceara

On Paraconsistent Belief Revision: the AGM rationality criteria revisited
Rafael Testa
State University if Campinas-UNICAMP

Venue - Main Building, Room 10

2:30PM-4:30PM

Social Epistemology: Research Teams and Scientific Communities
Symposia

Joint Commitments and the Distribution of Labor in Research Groups
Hanne Andersen
Aarhus University, Aarhus, DENMARK
Line E. Andersen
Aarhus University, Aarhus, DENMARK

The Matthew Effect and Trustworthiness in Research Teams
Karen Frost-Arnold
Hobart and William Smith Colleges

The Distribution of Epistemic Responsibilities in Scientific Communities and Research Groups
Kristina Rolin
University of Helsinki

Two Senses of Social in Social Epistemologies of Science
K. Brad Wray
SUNY Oswego

Venue - Main Building, Auditorium II

2:30PM-4:30PM

The Role of Abstractions and Generalizations in Systems and Synthetic Biology
Symposia

How to understand abstraction in modeling complex systems?
Tarja Knuuttila
University of South Carolina and University of Helsinki
Andrea Loettgers
University of Geneva and University of Bern

Constraint-based reasoning and mechanistic explanation
Sara Green
University of Copenhagen

Synthetic Biology and the Search for Potential Biological Systems: Taking How-Possibly Models Seriously
Rami Koskinen
University of Helsinki

Reevaluating the Goals of Systems Biology: Abstraction and Uncertainty
Miles MacLeod
University of Helsinki

Venue - Main Building, Room 15

4:30PM-5:00PM

Coffee

Venue - Main Building, new side

5:00PM-7:00PM

C3. Invited Session: Philosophy of the Life Sciences
Invited Sessions

Chair
Tarja Knuuttila, University of South Carolina

The Transnational Turn in the History of Science
Ana Barahona
National Autonomous Univeristy of Mexico UNAM, México, MEXICO

Information and Causation in Biology
Paul E. Griffiths
University of Sydney, Sydney, AUSTRALIA

Venue - Main Building, Small Hall

5:00PM-7:00PM

Let's act! - Formal models of collective agency, intention, and responsibility IV
Affiliated Meetings

Organized by
Frederik Van De Putte, Ghent University

Knowledge based oughts for individuals and groups (17:00 – 18:00)
John Horty, University of Maryland

Knowledge and Agency of Groups under Uncertainty (18:00 – 19:00)
Roberto Ciuni, Rein-Ruhr Universität Bochum

Venue - Main Building, Room 5

5:00PM-7:00PM

Logical, Modelling and Philosophical Foundations of Science - Historical Development, Current Investigations and Perspectives IV
Affiliated Meetings

Organized by
Boris Chendov, independent scholar
Peeter Müürsepp, Tallinn University of Technology
Arto Mutanen, Finnish National Defence University

To what extent I. Prigogine's non-linear thermodynamics is responsible for the philosophical talks about self-organization
Alexander Pechenkin
Russian Academy of Sciences & Lomonosov Moscow State University

Strong and weak influences in practice of modern western medicine and in philosophy of Chinese (Orient) medicine
Yulija P. Chukova
The Moscow Society of Researchers of Nature

New times for scientific communication
Fátima Masot-Conde
University of Seville

Two methodological theses concerning application of the modelling and logic to foundations of psycho-somatic medicine
Toshka Mikhajlova
independent scholar
Boris Chendo
independent scholar

Venue - Main Building, Auditorium IV

5:00PM-7:00PM

The Legacy of Joachim Lambek (FoLLI affiliated meeting) IV
Affiliated Meetings

Organized by
Michael Moortgat, Utrecht University
Philip Scott, University of Ottawa

From Lambek Calculus to Placement Calculus (40 min)
Glyn Morrill
Universitat Politecnica de Catalunya

Calibrating grammatical composition (40 min)
Michael Moortgat
Utrecht University

+ Closing discussion

Venue - Main Building, Room 3

5:00PM-6:00PM

Teaching Commission: Innovative and Effective Teaching in Undergraduate Philosophy of Science and Logic
Commission Sessions

Organizer
Michael R. Matthews, University of New South Wales

Teaching Logic to undergraduate students in Psychology with Moodle
Zuraya Monroy-Nasr
Psychology Department, National Autonomous University of Mexico, MEXICO

Teaching with Argument Maps
Zeynep Soysal
Philosophy Department, Harvard University, USA

Teaching Philosophy of Cognitive Science
Anna-Mari Rusanen
Philosophy Department, University of Helsinki, FINLAND

Linking Philosophy and History in a Unified Story: How Epistemology of Science Emerges from Scientists' Biographies.
Marta Bertolaso
Faculty of Medicine, Università di Roma, ITALY

Elements of Critical and Computational Thinking in Education of Pre-school Children
Hubert Bożek
Department of Logic and Methodology of Sciences, Institute of Philosophy and Sociology, Pedagogical University of Cracow, POLAND

Venue - Main Building, Room 13

6:00PM-7:00PM

Teaching Commission: Philosophy of Science and Science Teaching: Contributions from the Springer International Handbook of Research in HPS and Science Teaching
Commission Sessions

Organizer
Michael Matthews, University of New South Wales

Introduction and Overview of *Handbook*
Michael Matthews
School of Education, University of New South Wales, Australia

Generative Modelling in Physics and in Physics Education
Ismo T. Koponen and Suvi Tala
Physics Department, University of Helsinki, Finland

The History and Philosophy of Science and Science Teaching in Mexico
Ana Barahona
Biology Department, Autonomous University Mexico, Mexico

HPS and Challenges of Multiculturalism in Science Education
Kai Horsthemke
School of Education, University of the Witwatersrand, South Africa

Venue - Main Building, Room 13

5:00PM-7:00PM

A1.4 Mathematical Logic + C3.6 Philosophy of the Life Sciences
Contributed Papers

Chair
Puncochár Vít, Institute of Philosophy, Czech Academy of Sciences

Combining relational and algebraic semantics
Puncochár Vít
Department of Logic, Institute of Philosophy, Czech Academy of Sciences, Prague, CZECH REPUBLIC

The modal logic of symmetric forcing
Alexander Carstensen Block
Department of Mathematics, University of Hamburg, Hamburg, GERMANY

The proof-theoretic approach to evolutionary biology - can we work out a logic of evolution?
Andreea Esanu
Theoretical Philosophy and Logic, University of Bucharest, Bucharest, ROMANIA

Quantified intuitionistic and modal logic over metrizable spaces
Philip Kremer
Philosophy, University of Toronto Scarborough, Toronto, CANADA

Venue - Main Building, Room 17

5:00PM-7:00PM

A2.4 Philosophical Logic
Contributed Papers

Chair
Juhani Yli-Vakkuri, University of Oslo

The Logic of Vagueness and Modality
Juhani Yli-Vakkuri
CSMN, University of Oslo, Oslo, NORWAY
Jon Litland
Department of Philosophy, University of Texas at Houston, Austin, TX, USA

The Logic of the Indicative Conditional: An Expressivist Analysis
John Cantwell
Philosophy, Royal Institute of Technology, STOCKHOLM, SWEDEN

Implicational Logics and iterated Modus Ponens
Jui-Lin Lee
Center for General Education, National Formosa University, Yunlin County, TAIWAN

Logic and the Sense of Necessity
David Graves
General Studies, Academic College of Tel Aviv, Tel Aviv, ISRAEL

Venue - Main Building, Room 7

5:00PM-7:00PM

A2.6 Philosophical Logic
Contributed Papers

Chair
Jose Martinez Fernandez, University of Barcelona

Gödel's Claim that Intuitionistic Logic is a Renaming of Classical Logic and Davidsonian Radical Interpretation: Some Considerations
Fabrice Pataut
FRE 3593, CNRS, Paris, FRANCE

Two perspectives towards many-valued logic: philosophical and mathematical one
Mateusz Radzki
Department of Philosophy, The M. Grzegorzewska Academy of Special Education, Warsaw, POLAND

Classical many-valued logic and the bottom-line preservation notion of logical consequence
Ken Akiba
Philosophy, Virginia Commonwealth University, Richmond, USA

Belnap's logic as a logic of experts
Jose Martinez Fernandez
Logic, History and Philosophy of Science, University of Barcelona, Barcelona, SPAIN

Venue - Main Building, Room 8

5:00PM-7:00PM

B1.11 Methodology
Contributed Papers

Chair
Dunja Seselja, Ruhr-University Bochum

On Science and Humanism
Menashe Schwed
Philosophy, Ashkelon Academic College, Ashkelon, ISRAEL

Causal Pluralism in Political Science: Integration or Incommensurability?
Sharon Crasnow
Arts, Humanities, and World Languages, Norco College, Norco California, USA

Analytic Method
Miloš Kosterec
Department of Logic and Methodology of Science, Comenius University in Bratislava, Bratislava, SLOVAKIA

Can Scientific Rationality be Subsumed under Instrumental Rationality?
Dunja Seselja
Institute for Philosophy II, Ruhr-University Bochum, Bochum, GERMANY

Venue - Main Building, Room 6

5:00PM-7:00PM

B2.3 Formal Philosophy of Science and Formal Epistemology
Contributed Papers

Chair:
Nicola Angius, University of Sassari

Expediting the Flow of Knowledge versus Rushing into Print
Remco Heesen
Philosophy, Carnegie Mellon University, Pittsburgh, PA, USA

Decision Theoretic Analysis of the Productivity Puzzle
Liam Bright
Philosophy, Carnegie Mellon, Pittsburgh, USA Carole Lee, Washington, Seattle, USA

Defending the Semantic View of Theories. A Computer Science Perspective
Nicola Angius
History, Human Science, and Education, University of Sassari, Sassari, ITALY
Petros Stefaneas
Department of Mathematics, National Technical University of Athens, Athens, GREECE

Venue - Main Building, Room 14

5:00PM-7:00PM

B4.2 Ethical and Political Issues in the Philosophy of Science
Contributed Papers

Chair
Inkeri Koskinen, University of Helsinki

Characteristics of TA institutions by the Difference of Governance
Seung Ryong Lee
Office of Strategic Foresight, Korea Institute of S&T Evaluation and Planning, SEOUL, SOUTH KOREA

How can Bayesians help communications on climate change?
Tetsuji Iseda
Philosophy and History of Science, Kyoto University, Kyoto, JAPAN

Think Tank Research as Scientific Expertise
Anita Välikangas
Department of Political and Economic Studies, University of Helsinki, Helsinki, FINLAND

A New Problem of Demarcation: Extra-academic knowledge in academic research and the challenge of objectivity
Inkeri Koskinen
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

Venue - Main Building, Room 4

CLMPS 2015 PROGRAMME – TUESDAY 4 AUGUST

5:00PM-7:00PM

C1.2 Philosophy of the Formal Sciences
Contributed Papers

Chair
Raffaele Mascella, University of Teramo

Idea of triple determination of mathematical reality
Valentin Bazhanov
Department of Philosophy, Ulyanovsk State University, Ulyanovsk, RUSSIAN FEDERATION

Goodman and Mathematics
Caroline Jullien
LHSP-Archives Henri Poincaré, University of Lorraine, Nancy, FRANCE

Realism and instrumentalism in mathematics
Raffaele Mascella
Science Communication, University of Teramo, Teramo, ITALY

A naturalized approach to indispensability
Henri Galinon
Philosophie, Université Blaise Pascal, Clermont Ferrand, FRANCE

Venue - Main Building, Room 10

5:00PM-7:00PM

C2.3 Philosophy of the Physical Sciences
Contributed Papers

Chair
Caroline Elisa Murr, GLFC, UFSC

The conceptual foundations of Symmetry Breaking and the origin of physics
Joseph Kouneiher
Sciences and technologies, Universite de Nice-Sophia Antipolis, Nice, FRANCE

Quotidian, scientific and fictitious objects under a Russell-Schrödingerian approach: the case of light
Caroline Elisa Murr
GLFC, UFSC, Florianópolis, BRAZIL

Prediction in General Relativity
Casey McCoy, Philosophy, University of California San Diego, La Jolla, USA

On two arguments for the non-renormalizability of gravity
Juliusz Doboszewski, Epistemology, Jagiellonian University, Krakow, POLAND

Venue - Main Building, Room 16

5:00PM-7:00PM

C7.1 Philosophy of Medicine
Contributed Papers

Chair
Leen De Vreese
Centre for Logic and Philosophy of Science, Ghent University

Towards a theory of scientific understanding in psychiatry
Leen De Vreese
Centre for Logic and Philosophy of Science, Ghent University, Gent, BELGIUM

The Semantics of Mental Disorders
Vesterinen Tuomas
Theoretical Philosophy, University of Helsinki, Helsinki, FINLAND

Remodeling Psychopathology: The Limits of Latent Variable Approaches
Georg Repnikov
Unit for History and Philosophy of Science, University of Sydney, Sydney, AUSTRALIA

Venue - Main Building, Room 15

5:00PM-7:00PM

Epidemiological Practices? An Integrative Approach to Epidemiological Causal Reasoning
Symposia

Medicine as design science
Anna Estany
Universidad Autónoma Barcelona and Andreu Ballús, Universidad Autónoma Barcelona

Clinical Reasoning: How to go about it?
Atocha Aliseda
Universidad Nacional Autónoma México

Data visualization as a form of graphic medical reasoning to find causal correlations
David Casacuberta
Universidad Autónoma Barcelona

Statistics or Web of Statistical Procedures in Epidemiological Practices? An Integrative Approach to Epidemiological Causal Reasoning
Jordi Vallverdú
Universidad Autónoma Barcelona

Venue - Main Building, Auditorium II

5:00PM-7:00PM

Symposium on Danielle Macbeth's Realizing Reason: A Narrative of Truth and Knowing (Oxford UP 2014)
Symposia

Chair
Erich Reck, University of California, Riverside

Author Meets Critics: Danielle Macbeth, *Realizing Reason: A Narrative of Truth and Knowing*
Author: Danielle Macbeth (Haverford College)
Critic 1: Juliette Kennedy (University of Helsinki)
Critic 2: José Ferreirós (University of Seville)

Venue - Main Building, Room 12

7:30PM-9:30PM

City Visit
Social Events

Price: 15 €, FULL BOOKED. Ask for last minute cancellations at the registration desk.

Starting point: Senate Square

Choose either **Helsinki City Walk** or **Helsinki Bus Tour.**
Helsinki City Walk Explore the city center of Helsinki on a Guided City Walk. The guide will take you on a tour through the streets of Helsinki and tell you fascinating stories behind it. See the historical quarters around the Senate Square and feel the sea breeze while walking along the colourful Market Square. During the tour you will get suggestions on what to do and where to go in Helsinki. **Helsinki Bus Tour** During the tour you will see the beautiful Helsinki Cathedral at the Senate Square, the famous church built inside a rock, the Temppeliaukio church and the Sibelius Monument. Your guide will tell you about living in Helsinki in the past and at the present day. Enjoy a tailored tour to the sights that interest you the most.

Venue - Senate Square, next to Main Building

WEDNESDAY 5 AUGUST

9:00AM-10:30AM

Plenary Lecture: Harold Kincaid
Plenary Lectures

Chair
Hannes Leitgeb, LMU Munich

Scientific Realism, Models and the Social and Behavioral Sciences
Harold Kincaid
University of Cape Town, SOUTH AFRICA

Venue - Main Building Great Hall

9:00AM-10:50AM

The Logical Structure of Correlated Information Change (LogiCIC) I
Affiliated Meetings

Organized by
Sonja Smets, University of Amsterdam

Schedule:

09:00-09:30 lecture by Eric Pacuit, University of Maryland
09:30-09:40 Commentator 1 : TBA
09:40-09:50 Commentator 2 : Chenwei Shi, University of Amsterdam

09:50-09:55 Discussion

09:55-10:25 lecture by Branden Fitelson, Rutgers University
10:25-10:35 Commentator 1 : Kevin T. Kelly, Carnegie Mellon University
10:35-10:45 Commentator 2 : Zoe Christoff, University of Amsterdam

10:45-10:50 Discussion

Venue - Main Building, Room 7

10:30AM-11:00AM

Coffee

Venue - Main Building, new side

11:00AM-1:00PM

B2. Invited Session: Formal Philosophy of Science and Formal Epistemology
Invited Sessions

Chair
Adam Grobler, Opole University

Bayesian Philosophy of Science
Stephan Hartmann
LMU Munich, GERMANY

The credit economy and the economic rationality of science
Kevin Zollman
Carnegie Mellon University, USA

Venue - Main Building, Small Hall

11:00AM-1:00PM

B5. Invited Session: Historical Aspects in the Philosophy of Science
Invited Sessions

Chair
Thomas Uebel,University of Manchester

On theories
William Demopoulos (to be presented by Thomas Uebel),
The University of Western Ontario London, CANADA

At the Roots of Probabilistic Epistemology
Maria Carla Galavotti
Department of Philosophy and Communication, University of Bologna, ITALY

Venue - Main Building, Room 5

11:00AM-1:30PM

Mathematical Objectivity by Representation I
Affiliated Meetings

Organized by
Florian Steinberger, CMP, LMU, Munich
Marco Panza, CNRS, IHPST, Paris

The Role of Representation in Explanatory Proofs (11.00-11.45)
Gerhard Heinzmann
Laboratoire d'Histoire des Sciences et de Philosophie — Archives Henri-Poincaré, Université de Lorraine/CNRS, Nancy

Representing inferences and proofs: the case of harmony and conservativity (11:45 – 12:30)
Alberto Naibo IHPST, Univ. of Paris 1 Panthéon Sorbonne

What are Structural Properties? (12:30 – 13:15)
Johannes Korbmacher MCMP

Venue - Main Building, Room 8

11:00AM-1:00PM

A2.11 Philosophical Logic
Contributed Papers

Chair
Tuukka Tanninen, University of Helsinki

Assertion and the logic of common knowledge
Syraya Chin-mu Yang
Department of Philosophy, National Taiwan University, Taipei, TAIWAN

Dynamic justification logic
Alessandro Giordani
Philosophy, Catholic University of Milan, Saronno, ITALY

Intentional identity in epistemic logic
Tuukka Tanninen
Philosophy, History, Culture and Art Studies, University of Helsinki, Helsinki, FINLAND

An analysis of the problem of logical omniscience of epistemic logic
Ren-June Wang
Philosophy, National Chung Cheng University, Chiayi County, TAIWAN

Venue - Main Building, auditorium I

11:00AM-1:00PM

A2.8 Philosophical Logic
Contributed Papers

Chair
John Kearns, University at Buffalo

The predicate approach to de re modalities
Volker Halbach
Philosophy, Oxford University, Oxford, UNITED KINGDOM

On the Decidability of Atomic Mereological Theories
Hsing-chien Tsai
Philosophy, National Chung-Cheng University, Chia-yi, TAIWAN

A Hypersequent Calculus for Contingent Existence
Rohan French
Theoretical Philosophy, University of Groningen, Groningen, NETHERLANDS

Illocutionary Acts and Arguments
John Kearns
Philosophy, University at Buffalo, suny, buffalo, NY, USA

Venue - Main Building, Room 15

11:00AM-1:00PM

A4.2 Historical Aspects of Logic
Contributed Papers

Chair
Stephen Read, University of St Andrews

The Logic of Avicenna between al-Qiyas and Mantiq al-Mashriqiyin
Saloua Chatti
Philosophy, University of Tunis, Tunis, TUNISIA

Non normal modal logica in Thomas Aquinas
Luca Gili
Philosophy, KU Leuven, Leuven, BELGIUM

Richard Kilvington and the Theory of Obligations
Stephen Read
Arché Research Centre, University of St Andrews, St Andrews, UNITED KINGDOM

Aristotelian Diagrams for Multi-Operator Formulas in Avicenna and Buridan
Hans Smessaert
Department of Linguistics, KU Leuven, Leuven, BELGIUM
Lorenz Demey
Center for Logic and Analytic Philosophy, KU Leuven, Leuven, BELGIUM

Venue - Main Building, Room 14

11:00AM-1:00PM

B1.3 Methodology
Contributed Papers

Chair
Joke Meheus, Ghent University

Philosophy and Methodology of Change: Systems of Change as an Object of General Change Methodology
Oleksandr Melnychenko
Department of Information Technology, Kherson National Technical University, Kherson, UKRAINE

Scientific Thought Experiments and their Context: Einstein's Magnet-Conducto
Jan Potters
Philosophy and Moral Sciences, Ghent University, Ghent, BELGIUM

Comprehensive Epistemology and the Philosophy of Science
Nicholas Ray
Philosophy, University of Waterloo, Guelph, CANADA

Inconsistency Handling in the Sciences: Where and How Do We Need Paraconsistency?
Joke Meheus
Centre for Logic and Philosophy of Science, Ghent University, Ghent, BELGIUM

Venue - Main Building, Room 13

11:00AM-1:00PM

B1.4 Methodology
Contributed Papers

Chair
Saana Jukola, University of Jyväskylä

Journal Peer Review, Biases, and the Objectivity of Research
Saana Jukola
Department of Social Sciences and Philosophy, University of Jyväskylä, Jyväskylä, FINLAND

How trading zones may help solving communication problems in the sciences
João Mendes
Philosophy, University of Minho, Braga, PORTUGAL

Considering the Quantum Hypothesis in the Context of Pursuit
Molly Kao
Philosophy, University of Western Ontario, London, CANADA

Venue - Main Building, Room 3

11:00AM-1:00PM

B3.2 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Marion Godman, University of Cambridge and University Helsinki

Causation and Spatial Scale
Joshua Kelleher
School of History, Philosophy, Religion & Classics, The University of Queensland, St Lucia, AUSTRALIA

Nested Hierarchies and the Structure of Ecology
David McElhoes
Philosophy, Arizona State University, Phoenix, USA

Towards an Account of Scientific Constitution
Totte Harinen
Department of Philosophy, King's College London, London, UNITED KINGDOM

Scientific Realism, Historical Essences, and Species
Marion Godman
HPS, University of Cambridge and University Helsinki, UNITED KINGDOM

Venue - Main Building, Room 12

11:00AM-1:00PM

C1.3 Philosophy of the Formal Sciences
Contributed Papers

Chair
Greg Restall, University of Melbourne

Composition, Identity and Emergence
Claudio Calosi
Basic Science and Foundations, University of Urbino, Urbino, ITALY

On the significance of categoricity arguments
Adrian Ludusan
G. Zane Institute for Economic and Social Research, Romanian Academy, Iași branch, Iași, ROMANIA

Proper Classes, Forcing Extensions, and Universism; Understanding the role of simulation in mathematics
Neil Barton
Philosophy, Birkbeck College, London, UNITED KINGDOM

Fixed Point Models for Theories of Properties and Classes
Greg Restall
School of Historical and Philosophical Studies, University of Melbourne, Parkville, AUSTRALIA

Venue - Main Building, Room 10

11:00AM-1:00PM

C2.4 Philosophy of the Physical Sciences
Contributed Papers

Chair
Massimiliano Badino, Universitat Autònoma de Barcelona / MIT

Typicality in Statistical Mechanics: An Epistemological Approach
Massimiliano Badino
Philosophy, Universitat Autònoma de Barcelona / MIT, Bellaterra (Barcelona), SPAIN

On the probabilistic approach to renormalization
Jeremy Butterfield
Philosophy, Trinity College, Cambridge, Cambridge, UNITED KINGDOM

On How to Approach the Approach to Equilibrium
Joshua Luczak
Philosophy, University of Western Ontario, London, CANADA

Venue - Main Building, Room 6

11:00AM-1:00PM

C3.2 Philosophy of the Life Sciences
Contributed Papers

Chair
Matsumoto Shunkichi, Tokai University

Evolutionary and Molecular Genes: The Case of Cystic Fibrosis
Matsumoto Shunkichi
Liberal Arts Education Center, Tokai University, Kanagawa, JAPAN

On the Concept of Genetic Distance: the perils of misinterpretation
Omri Tal
Theoretical and Mathematical Biology, Max Planck Inst. for Mathematics in the Sciences, Leipzig, GERMANY

Fitness and Variance
Brad Weslake
Philosophy, NYU Shanghai, Shanghai, CHINA

On the relation between biological information and biological inheritance
María José Ferreira Ruiz
Department of Philosophy, University of Buenos Aires - CONICET, Ciudad Autónoma de Buenos Aire, ARGENTINA

Venue - Main Building, Room 17

11:00AM-1:00PM

C4.2 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
António Zilhão, University of Lisbon

Cognition and Rationality: Writing Straight with Crooked Lines?
António Zilhão
Philosophy, University of Lisbon, Lisboa, PORTUGAL

A Case for Eliminativism about Biases
Andrea Polonioli
Philosophy, University of Edinburgh, Edinburgh, UNITED KINGDOM

Unrevisability as the mark of delusions
Patrice Soom
Philosophy, Heinrich-Heine Universität, Düsseldorf, GERMANY
Gottfried Vosgerau
Philosophy, Heinrich-Heine Universität, Düsseldorf, GERMANY

Venue - Main Building, Room 4

11:00AM-1:00PM

C5.2 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
Paul Hoyningen-Huene, Leibniz Universität Hannover

The future – and present – of work and its rules facing technological transformations
Tomaso Greco
Diritto, Economia e Culture (DEC), Università degli Studi dell'Insubria, Como, ITALY

To what extent economic explanations are distinctively mathematical?
Lukasz Hardt
Department of Economics, University of Warsaw, Warsaw, POLAND

Appreciation Problems of Neuroeconomics
Paul Hoyningen-Huene
Philosophy, Leibniz Universität Hannover, Hannover, GERMANY

Dealing with plurality in scientific practice: The case of International Political Economy
Jeroen Van Bouwel
Philosophy and Moral Science, Ghent University, Gent, BELGIUM

Venue - Main Building, Room 16

11:00AM-1:00PM

Models and pluralism in the health sciences
Symposia

Representing and explaining: On modeling disorders
Raffaella Campaner
University of Bologna
Marta Bertolaso
University Campus Bio-Medico

Questioning the usefulness of mechanistic models for predicting which medical treatments will benefit humans
Jeremy Howick
University of Oxford

DAGgers at dawn? Understanding the potential outcomes "revolution" in epidemiology
Alex Broadbent
University of Johannesburg

Pluralism in research on Post-traumatic Stress Disorder: Implications for clinical practice
Robyn Bluhm
Old Dominion University

Venue - Main Building, Auditorium IV

1:00PM-2:30PM

Lunch
Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with LC 2015) for participants who have purchased the additional lunch package (60,60 €).

Venue - Main Building Unicafe

2:30PM-4:30PM

A1. Invited Session: Mathematical Logic
Invited Sessions

Chair
Åsa Hirvonen, University of Helsinki

Constructing normal numbers
Verónica Becher
University of Buenos Aires, ARGENTINA CONICET, ARGENTINA

Entanglement and Formalism Freeness: Templates from Logic and Set Theory
Juliette Kennedy
University of Helsinki, FINLAND

Venue - Main Building, Small Hall

2:30PM-4:30PM

B3. Invited Session: Metaphysical Issues in the Philosophy of Science
Invited Sessions

Chair
Jaakko Kuorikoski, University of Helsinki

What gives Direction to Time?
Loewer Barry
Rutgers University, USA

On the Prospects of an Effective Metaphysics
Kerry McKenzie
UC San Diego, USA

Venue - Main Building, Room 5

2:30PM-4:20PM

The Logical Structure of Correlated Information Change (LogiCIC) II
Affiliated Meetings

Organized by
Sonja Smets, University of Amsterdam

Schedule:

14:30-15:00 TBA 15:00-15:10
Commentator 1: Olivier Roy, University of Bayreuth
15:10-15:20 Commentator 2: Sonja Smets, University of Amsterdam

15:20-15:25 Discussion

15:25-15:55 lecture by Kevin T. Kelly, Carnegie Mellon University
15:55-16:05 Commentator 1: Alexandru Baltag, University of Amsterdam
16:05-16:15 Commentator 2: Soroush R. Rad, University of Amsterdam

16:15-16:20 Discussion

Venue - Main Building, Room 7

2:30PM-4:45PM

Mathematical Objectivity by Representation II
Affiliated Meetings

Organized by
Florian Steinberger, CMP, LMU, Munich
Marco Panza , CNRS, IHPST, Paris

Structuralism Based on a Computable Infinitary Logic (14:30 – 15:15)
Catrin Campbell-Moore, MCMP

Reference graphs, games for truth, and semantic paradox (15:15 – 16:00)
Thomas Schindler, MCMP

Dummett and "Kresiel Dictum" (16:00 – 16:45)
Göran Sundholm, University of Leiden

Venue - Main Building, Room 8

2:45PM-5:45PM

A Social Philosophy of Science: An Affiliated Meeting
Affiliated Meetings

Organizer
Ilya Kasavin, Institute of Philosophy

How an affordance based on philosophy of chemistry makes room for social and personal factors in the research process?
Rom Harré, Georgetown University, USA

Social Philosophy of Science: A New Turn in STS
Ilya Kasavin, Institute of Philosophy, RAS, Russia

Venue - Main Building, Auditorium IV

2:30PM-4:30PM

Session of the Commission on Technology and Engineering Sciences: Complex Socio-Technical Systems: Frames and Values I
Commission Sessions

Organized by
Sjoerd Zwart, Delft University of Technology

The Crucial Role of Stakeholders in CST- Systems
Nicola Guarino, ISTC-CNR

Context as a modelling device for CST systems
Stefano Borgo, CNR (National Council of Research)

The Socio-Technical Stance
Daniele Porello, CNR (National Council of Research)
Roberta Ferrario, Italian National Research Council

Sociotechnical systems and their users
Maarten Franssen, Delft University of Technology

Venue - Main Building, Auditorium II

2:30PM-4:30PM

A2.10 Philosophical Logic
Contributed Papers

Chair
Valentin Goranko, Stockholm University

Justification Logics and Quasi-Truth
Alexandre Costa-Leite
Philosophy, University of Brasilia, Brasilia, BRAZIL

Beyond knowing that: non-standard epistemic logics
Yanjing Wang
Department of Philosophy, Peking University, Beijing, CHINA

Propositional Logics of Dependence and Relativised Knowledge
Valentin Goranko
Department of Philosophy, Stockholm University, Stockholm, SWEDEN Antti Kuusisto, Stockholm University, Stockholm, SWEDEN

Truth-functional approach to epistemic logic (and its application to Fitch's paradox)
Ekaterina Kubyshkina
Philosophy , l'Université Paris 1, IHPST, Paris, FRANCE

Venue - Main Building, Room 15

2:30PM-4:30PM

A2.9 Philosophical Logic
Contributed Papers

Chair
Ulrich Meyer, Colgate University

Dependence of quantifiers: Arbitrary objects versus generalised Tarski-type semantics
Gabriel Sandu
Philosophy, History, Culture and Art Studies, University of Helsinki, Helsinki, FINLAND

Words or Things: Aristotelian Categories
Esra Cagri Mutlu
Philosophy, VAN YYU, Van, TURKEY

Logical Spaces
Ulrich Meyer
Philosophy, Colgate University, Hamilton, USA

Heterodox Models of Peano Arithmetic
Taishi Kurahashi
Natural Sciences, Kisarazu National College of Technology, Kisarazu, Chiba, JAPAN
Makoto Kikuchi
System Informatics, Kobe University, Kobe, JAPAN

Venue - Main Building, Room 13

2:30PM-4:30PM

B1.10 Methodology
Contributed Papers

Chair
Arturo R. Argott, UNAM

Why is Representation Communal Rather than Private?
Brandon Boesch
Philosophy, University of South Carolina, Columbia, USA

The Role of Subjective Models in Proto-Scientific Measurement
Alistair Isaac
Philosophy, University of Edinburgh, Edinburgh, UNITED KINGDOM

Scientific understanding as guidance of and for cognitive activity
Arturo R. Argott
Philosophy, UNAM, Estado de Mexico, MEXICO

Is scientific innovation rationally intelligible?
Thomas Sturm
Department of Philosophy, Autonomous University of Barcelona, Bellaterra (Barcelona), SPAIN

Venue - Main Building, Room 12

2:30PM-4:30PM

B3.12 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Vladimir Havlik, Institute of Philosophy, Prague 1

Robert Boyle's chemistry and the ontological status of dispositional properties
Hugo Fraguito, Philosophy, New University of Lisbon, Lisbon, PORTUGAL

The 'One-world' Interpretation of Kantian Trascendentalism?? View of Quantum Non-Separability
Pandora Hadzidaki
Philosophy and History of Science, University of Athens, Athens, GREECE

The logical form of laws of nature
Toby Friend
Science and Technology Studies, UCL, London, UNITED KINGDOM

Natural vs. Artificial Distinction
Vladimir Havlik
Department of Analytical Philosophy, Institute of Philosophy, Prague 1, CZECH REPUBLIC

Venue - Main Building, Room 17

2:30PM-4:30PM

B4.3 Ethical and Political Issues in the Philosophy of Science
Contributed Papers

Chair
Justin Biddle, Georgia Institute of Technology

Inductive Risk, Epistemic Risk, and Overdiagnosis of Disease
Justin Biddle
Philosophy Program, School of Public Policy, Georgia Institute of Technology, Atlanta, USA

Value free or not, in terms of whether qua science or qua scientists
Masahiro Matsuo
Science, Hokkaido University, Sapporo, JAPAN

Venue - Main Building, Room 16

2:30PM-4:30PM

C1.4 Philosophy of the Formal Sciences
Contributed Papers

Chair
Andrea Sereni, Institute of Advanced Studies IUSS

Mathematics in Structural Explanations
Min Tang, Philosophy
University of North Carolina Chapel Hill, Chapel Hill, USA

State constraint system applicable to judgement adjusting
Susumu Yamasaki
Computer Science, Okayama University, Okayama, JAPAN

Keeping Pure and Applied Mathematics Together: the Role of Frege's Constraint
Andrea Sereni
Humanities, Institute of Advanced Studies IUSS, Pavia, ITALY

Indiscernibility in mathematics
Brice Halimi
Philosophy, University Paris Ouest, Nanterre, FRANCE

Venue - Main Building, Room 10

2:30PM-4:30PM

C2.5 Philosophy of the Physical Sciences
Contributed Papers

Chair
Erik Curiel, Ludwig-Maximilians-Universität

Causal Sets and Discrete Linear Structures
Laurenz Hudetz
Department of Philosophy (KGW), University of Salzburg, Salzburg, AUSTRIA

Testing typicality in multiverse cosmology
Feraz Azhar
Department of History and Philosophy of Science, University of Cambridge, Cambridge, UNITED KINGDOM

Measure, Topology and Probabilistic Reasoning in Cosmology
Erik Curiel
Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universität, Munich, GERMANY

Bayesian Perspectives on the Discovery of the Higgs Particle
Richard Dawid
Philosophy, LMU Munich, Munich, GERMANY

Venue - Main Building, Room 6

2:30PM-4:30PM

C7.4 Philosophy of Medicine
Contributed Papers

Chair
James Krueger, University of Redlands

Disease definitions and the case of Morgellons
Harry Quinn Schone
Science and Technology Studies, UCL, London, UNITED KINGDOM

Individuating Pathologies
James Krueger
Philosophy, University of Redlands, Redlands, USA

Animal Predictions of Human Responses
Nina Atanasova
Philosophy and Religious Studies, The University of Toledo, Toledo, USA

The concept of animal in husbandry and impact on therapeutical choices
Jacques Cabaret
Animal health, INRA, Nouzilly, FRANCE Ludivine Fortin, Animal health, INRA, Nouzilly, FRANCE

Venue - Main Building, auditorium I

2:30PM-4:30PM

C7.5 Philosophy of Medicine + C8.4 Metaphilosophy
Contributed Papers

Chair
Judith Favereau, University of Helsinki

Making Better People through Technologies and Without Norms - Disciplinary Transfers from Medicine to Enhancement
Johanna Ahola-Launonen
Political and Economic Studies , University of Helsinki, Helsinki, FINLAND
Judith Favereau
Political and Economic Studies, University of Helsinki, Helsinki, FINLAND

How Modern Technology Shapes Death
Sheng-Ying Lu
College of Philosophy & Sociology, Beijing Normal University, Beijing, CHINA

Perceptual Knowledge of Nonactual Possibilities
Margot Strohminger
Centre for Philosophical Psychology, University of Antwerp, Antwerp, BELGIUM

A formal definition of ontological categories
Pawel Garbacz
Department of Philosophy, The John Paul II Catholic University of Lublin, Radawiec Duzy, POLAND

Venue - Main Building, Room 14

2:30PM-4:30PM

Naming Logic(s)
Symposia

Organized by
Jean-Yves Beziau, Federal University of Rio de Janeiro

What makes symbolic logic "symbolic"?
Amirouhe Moktefi, Tallinn University of Technology

Formal and transcendental logic
Srecko Kovac, Institute of Philosophy, Zagreb

What is pure in Husserl's idea of pure logic?
Manuel Gustavo Isaac, Paris Diderot University

On the minimality of minimal logic
Sergei Odintsov, Sobolev Institute of Mathematics

Venue - Main Building, Room 3

2:30PM-4:30PM

Suppositiones and Consequentiae in Medieval Logic: Historical and Philosophical Inquiries
Symposia

Consequentiale and Expositiones in Marsilius of Inghen's Treatise on Consequences
Graziana Ciola, Scuola Normale Superiore / UCLA

Collective Nouns and Plural Quantification in William of Ockham
Magali Roques, Freie Universität Berlin

Two medieval traditions in the meaning of 'formally valid'
Mikko Yrjönsuuri, University of Jyväskylä

Venue - Main Building, Room 4

4:30PM-5:00PM

Coffee

Venue - Main Building, new side

4:40PM-6:30PM

The Logical Structure of Correlated Information Change (LogiCIC) III
Affiliated Meetings

Organized by
Sonja Smets, University of Amsterdam

Schedule:

16:40-17:10 lecture by Alexandru Baltag, University of Amsterdam
17:10-17:20 Commentator 1: Branden Fitelson, Rutgers University
17:20-17:30 Commentator 2: Paolo Galeazzi, University of Amsterdam

17:30-17:35 Discussion

17:35-18:05 lecture by Olivier Roy, University of Bayreuth
18:05-18:15 Commentator 1: Eric Pacuit, University of Maryland
18:15-18:25 Commentator 2: Sonja Smets, University of Amsterdam

18:25-18:30 Discussion - Closing words : Sonja Smets

Venue - Main Building, Room 7

CLMPS 2015 PROGRAMME – WEDNESDAY 5 AUGUST

5:00PM-6:00PM

A1. Invited Session: Mathematical Logic
Invited Sessions

Chair
Åsa Hirvonen, University of Helsinki

Global Reflection Principles
P.D. Welch
School of Mathematics, University of Bristol, UNITED KINGDOM

Venue - Main Building, Small Hall

5:00PM-6:30PM

Session of the Commission on Technology and Engineering Sciences: Complex Socio-Technical Systems: Frames and Values II
Commission Sessions

Organized by
Sjoerd Zwart, Delft University of Technology

Design for Values and CST–Systems. The Role of Procedural Values and Institutional Design
Rafaela Hillebrand, RWTH Aachen University

Participation in Autonomous Systems
Sabine Thürmel, Technical University Munich

Venue - Main Building, Auditorium II

5:00PM-6:30PM

A3.4 Computational Logic and Applications of Logic
Contributed Papers

Chair
Michal Zawidzki, University of Lodz/University of Warsaw

Hybrid Logic for Qualitative Reasoning about Location
Michal Zawidzki
Institute of Philosophy, University of Lodz/University of Warsaw, Warszawa, POLAND
Tomasz Lechowski
Institute of Philosophy, University of Warsaw, Warszawa, POLAND
Przemyslaw Walega
University of Warsaw, Warszawa, POLAND

Contrary-to-Duty Imperatives: A Paraconsistent Deontic Approach
Can Baskent
Semagramme, INRIA, Vandoeuvre-lès-Nancy Cedex, FRANCE

Generalized Quantifiers and Higher-order Logic Programming
Peter Gabrovsky
Computer Science, California State University, Northridge, USA

Venue - Main Building, Room 3

5:00PM-6:30PM

B2.5 Formal Philosophy of Science and Formal Epistemology
Contributed Papers

Chair
David Miller, University of Warwick

An Economic Interpretation of Contrapositive Probability
David Miller
Philosophy, University of Warwick, COVENTRY, UNITED KINGDOM

Betting odds and sincere degrees of belief
Colin Elliot
Department of Philosophy, University of Tilburg, Tilburg, NETHERLANDS

Making Fit Fit
Michael Hicks
Philosophy, Rutgers University, Brooklyn, USA

Venue - Main Building, Room 12

5:00PM-6:30PM

B2.7 Formal Philosophy of Science and Formal Epistemology
Contributed Papers

Chair
Thomas Benda, National Yang Ming University

The logical form of physical statements
Thomas Benda
Institute of Philosophy of Mind, National Yang Ming University, Taipei, TAIWAN

Counterfactuals within Scientific Theories
Samuel C. Fletcher
Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universität München, Munich, GERMANY

Iterated Belief Revision and Nested Conditionals
Hao-Cheng Fu
Philosophy, Chinese Culture University, Taipei, TAIWAN

Venue - Main Building, Room 4

5:00PM-6:30PM

B3.13 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Jennifer Fellows, Douglas College

Hooking On and Biting Back: A Defense of Longino's Account of Objectivity
Jennifer Fellows
Philosophy, Douglas College, New Westminster, B.C., CANADA

Extended Agents and Development of Science and Technology
Yasuo Nakayama
Graduate School of Human Sciences, Osaka University, Suita, Osaka, JAPAN

Venue - Main Building, Room 14

5:00PM-6:30PM

B5.5 Historical Aspects in the Philosophy of Science
Contributed Papers

Chair
Julien Grupp, Université Montpellier III

Which Intuition for Intuitionism?
Julien Grupp
Philosophy, Université Montpellier III, Lodève, FRANCE

Operationalism and realism in Soviet theoretical physics
Alexander Fursov
Department of Philosophy, M.V. Lomonosov Moscow State University, Moscow, RUSSIAN FEDERATION

Venue - Main Building, Room 5

5:00PM-6:30PM

C2.13 Philosophy of the Physical Sciences + A2 Philosophical Logic
Contributed Papers

Chair
Daniele Chiffi, University of Padua

Likelihood and Confidence in the IPCC's Uncertainty Framework
Casey Helgeson
Philosophy, London School of Economics, London, USA

Epistemic and institutional challenges posed by the provision of climate services
Cecilia Hidalgo
School of Philosophy&Literature, University of Buenos Aires, Buenos Aires, ARGENTINA

A pragmatic logic for denial (LPD)
Massimiliano Carrara
FISPPA Department, University of Padua, Padova, ITALY
Daniele Chiffi
University of Padua, ITALY
Ciro De Florio
Catholic University of Milan, Milan, ITALY

Venue - Main Building, Room 16

5:00PM-6:30PM

C4.8 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
Marcin Mostowski, University of Warsaw

Learning Natural Language Semantics Through Coordination
Dariusz Kalocinski
Department of Logic, Institute of Philosophy, University of Warsaw, Warsaw, POLAND
Nina Gierasimczuk
Institute for Logic, Language and Computation, Amsterdam, NETHERLANDS
Marcin Mostowski
Institute of Philosophy, University of Warsaw, Warsaw, POLAND

Analogical Thinking in Formal Semantics
David Rey
Logic, History, and Philosophy of Science, University of Barcelona - LOGOS group, Barcelona, SPAIN

Venue - Main Building, Room 10

5:00PM-6:30PM

C4.9 Philosophy of the Cognitive and Behavioural Science
Contributed Papers

Chair
Denis Forest, University of Paris Ouest Nanterre La Défense

Cognitive neuroscience as a research tradition and a social practice: the case of episodic memory
Denis Forest
Philosophy, University of Paris Ouest Nanterre La Défense, Nanterre, FRANCE
Loraine Gérardin-Laverge
Philosophy, University of Paris Ouest Nanterre La Défense, Lyon, FRANCE

Inductive Inferences in Cognitive Neuroscience
Mika Kiikeri
School of Social Sciences and Humanities/ Philosoph, University of Tampere, Tampere, FINLAND

Cognitive Neuroscience and the Mechanist Thesis
Gordon Steenbergen
Philosophy, Duke University, Durham, NC, USA

Venue - Main Building, Room 17

5:00PM-6:30PM

C5.8 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
Yuliya Fadeeva, Duisburg-Essen University

Rejection of conceptual scheme relativism: A defense of Donald Davidson
Yuliya Fadeeva
Philosophy, Duisburg-Essen University, Essen, GERMANY

THE MEANING OF PEJORATIVES: Dependent and Independent Semantics
Pasi Valtonen
Department of Philosophy, King's College London, London, UNITED KINGDOM

Sense and reversed (retrograde) semiosis in the Humanities
Konstantin Skripnik
Institute of Philosophy and Social Studies, Southern federal university, Rostov-on-Don, RUSSIAN FEDERATION

Venue - Main Building, Room 6

5:00PM-6:30PM

C5.9 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
Olivier Ouzilou, Université de Lorraine

Memory, Reification and Methodology
Eugenia Allier-Montaño
Instituto de Investigaciones Sociales, Universidad Nacional Autonoma de Mexico, Mexico, D.F., MEXICO

The 'looping effect' and the specificity of the social sciences
Olivier Ouzilou
Université de Lorraine, Nancy, FRANCE

Venue - Main Building, Room 13

5:00PM-6:30PM

C6.3 Philosophy of the Applied Sciences and Technology
Contributed Papers

Chair
Carlo Martini, University of Helsinki

Health claims: regulation and scientific controversy
Oliver Todt
Philosophy, University of the Balearic Islands, Palma, SPAIN
José Luis Luján
Philosophy, University of the Balearic Islands, Palma, SPAIN
Juan Bautista Bengoetxea
Philosophy, University of the Balearic Islands, Palma, SPAIN

Measuring Risk by Subjective Indicators
Carlo Martini
Department of Political and Economic Studies, University of Helsinki, Helsinki, FINLAND

Philosophical notion of responsibility as a foundation for Value Sensitive Design and for Responsible Innovation
Rafal Wodzisz
Philosophy, John Paul II Catholic University of Lublin, Ropczyce, POLAND

Venue - Main Building, Room 15

5:15PM-6:45PM

Mathematical Objectivity by Representation III
Affiliated Meetings

Organized by
Florian Steinberger, CMP, LMU, Munich
Marco Panza , CNRS, IHPST, Paris

A New Norm for Truth (17.15-18.00)
Johannes Stern, MCMP

Reductive and hermeneutic Nominalism (18.00-18.45)
Kai Büttner, University of Zurich

Venue - Main Building, Room 8

6:30PM-8:00PM

City Hall Reception
Social Events

The City of Helsinki hosts a welcome reception for the congress quests at the heart of the historic centre next to the sea-side Market Square. After a welcome speech by a city representative, the guests have a chance to enjoy a light buffet dinner and the architecture of the City Hall.

The reception is also open for registered avecs!

Venue - Helsinki City Hall

THURSDAY 6 AUGUST

9:00AM-10:30AM

Plenary Lecture: Steve Awodey
Plenary Lectures

Chair
Jouko Väänänen, University of Helsinki

Cubical homotopy type theory and univalence
Steve Awodey
Carnegie Mellon University, Pittsburgh, UNITED STATES

Venue - Porthania I

10:30AM-11:00AM

Coffee

Venue - Main Building, new side

11:00AM-1:00PM

A2. Invited Session: Philosophical Logic
Invited Sessions

Chair
Greg Restall, University of Melbourne

Could there be no logic?
Gillian Russell
Department of Philosophy, Washington University St Louis, UNITED STATES

Logic Revision: Some Formal and Semi-Formal Techniques for Logic Choice
Edwin Mares
Victoria University of Wellington, NEW ZELAND

Venue - Main Building, Small Hall

11:00AM-12:00PM

C6. Invited Session: Philosophy of the Applied Sciences and Technology
Invited Sessions

Chair
Hanne Andersen, University of Copenhagen

How to bring philosophy back into science – *Epistemological constructivism* as a viable picture of science?
Mieke Boon
University of Twente, Enschede, NETHERLANDS

Venue - Main Building, Room 5

12:00PM-1:00PM

C7. Invited Session: Philosophy of Medicine
Invited Sessions

Chair
David Teira, UNED

Molecular medicine: the clinical method enters the lab – What primary tumor culture teaches us?
Giovanni Boniolo
University of Milan & IEO, Milano, ITALY

Venue - Main Building, Room 5

11:00AM-1:00PM

Philosophy of Mathematical Practice I
Affiliated Meetings

Sponsored by the Association for the Philosophy of Mathematical Practice (APMP).

Organized by
Andrew Arana, University of Illinois
Emily Grosholz, Penn State University
Dirk Schlimm, McGill University

Dedekind, Frege, and the foundational quest (11:00 – 11:30)
Erich Reck, University of California, Riverside

Frege on acquaintance (11:30 – 12:00)
Sorin Costreie, Romanian Academy, Iasi Branch

Formalization as a mathematical and philosophical tool (12:00 – 12:30)
John Baldwin, University of Illinois, Chicago

Impossibility theorems and the elimination of modality (12:30-13:30)
Davide Crippa, Université Paris Diderot

Venue - Main Building, Auditorium II

11:00AM-1:00PM

A1.1 Mathematical Logic
Contributed Papers

Chair
Luiz Carlos Pereira, PUC-Rio/UERJ

On Implicational Connectives of Quantum Logics for Non-commutative Substructural Logics formulated Gentzen-style Natural Deduction
Takeshi Ueno
Food Science and Human Wellnes, Rakuno-Gakuen University, Ebetsu, JAPAN

A theory for systems of propositions referring to each other
Denis Saveliev
Institute for Information Transmission Problems, Russian Academy of Sciences, Moscow, RUSSIAN FEDERATION

Logic and philosophy of trial and error mathematics: Dialectical and quasi-dialectical systems
Luca San Mauro
Faculty of Humanities, Scuola Normale Superiore, Pisa, ITALY
Jacopo Amidei
Faculty of Humanities, Scuola Normale Superiore, Pisa, ITALY
Duccio Pianigiani
Mathematics, University of Siena, Siena, ITALY
Andrea Sorbi
Mathematics, University of Siena, Siena, ITALY

Some general results on the translations between logics and theories
Luiz Carlos Pereira
Philosophy, PUC-Rio/UERJ, Rio de Janeiro, BRAZIL
Edward Hermann Haeusler
Computer Science, PUC-Rio, Rio de Janeiro, BRAZIL

Venue - Main Building, Room 16

11:00AM-1:00PM

A3.1 Computational Logic and Applications of Logic
Contributed Papers

Chair
Marie Duzi, VSB-Technical University Ostrava

Procedural specification of beta-conversion
Marie Duzi
Computer Science, VSB-Technical University Ostrava, Ostrava, CZECH REPUBLIC

A Behavioral Hierarchy of Strategy Logic
Luigi Sauro
Dipartimento di Ingegneria Elettrica e Tecnologie , Università di Napoli Federico II, Napoli, ITALY
Fabio Mogavero
Università di Napoli Federico II, Napoli, ITALY
Aniello Murano
Università di Napoli Federico II, Napoli, ITALY

Logics for Collective Reasoning
Daniele Porello
Institute of Cognitive Science and Technology, CNR (National Council of Research), Trento, ITALY

Modeling decision-making under ignorance and uncertainty
Tomasz Lechowski
Philosophy, University of Warsaw, Warsaw, POLAND
Michal Zawidzki
Philosophy, University of Lodz / University of Warsaw, Lódz, POLAND
Przemyslaw Walega
Philosophy, University of Warsaw, Warsaw, POLAND

Venue - Main Building, Room 15

11:00AM-1:00PM

B1.12 Methodology
Contributed Papers

Chair
Anne-Sophie Godfroy, Université Paris-Sorbonne & CNRS

Causal inference and public policy: problems and (some) solutions
Daniel Malinsky
Philosophy, Carnegie Mellon University, Pittsburgh, PA, USA

Gender index for the academia : how to translate the real world into numbers?
Anne-Sophie Godfroy
Sciences Normes Decision, Université Paris-Sorbonne & CNRS, Paris, FRANCE

Automated large scale evidence aggregation in the context of policy making
Nicolas Wüthrich
Philosophy, Logic, and Scientific Method, London School of Economics and Political Science, London , UNITED KINGDOM
Katie Steele, Philosophy, Logic, and Scientific Method, London School of Economics and Political Science, London, UNITED KINGDOM

The methodology of the logical and cultural dominant in cross – science communication
Galina Sorina
Faculty of Philosophy, Lomonosov Moscow State University, Moscow, RUSSIAN FEDERATION
Irina Griftsova
Department of Philosophy, Moscow State Pedagogical University, Moscow, RUSSIAN FEDERATION

Venue - Main Building, Room 7

11:00AM-1:00PM

B3.10 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Paul Teller, UC Davis

Pan-Perspectival Realism
Paul Teller
Philosophy, UC Davis, Davis, USA

Defining a Cumulative and Comprehensive Scientific Realism
Priyedarshi Jetli
Philosophy, University of Delhi, Delhi, INDIA

Recondstructed Empiricism
Finnur Dellsen
Department of Social Sciences, Bifrost University, Reykjavik, ICELAND

Abstraction, ideality and scientific representation
Kilakos Dimitris
Department of Philosophy and History of Science, University of Athens, Athens, GREECE

Venue - Main Building, Room 13

11:00AM-1:00PM

B3.4 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Anna-Mari Rusanen, University of Helsinki

Against Structural and Counterfactual Explanations of Highly-Idealized Models in Physics
Martin King
Philosophy, University of Guelph, Guelph, CANADA

Do we need an explanation of regularities?
Laura Felline
Philosophy, Universita' roma 3, rome, ITALY

Scientific Understanding and Explanatory Interest
Zhu Xu
Philosophy, University of Chinese Academy of Sciences, Beijing, CHINA

On Characterizing Relevance
Anna-Mari Rusanen
Philosophy, history, culture and art studies, University of Helsinki, Helsinki, FINLAND

Venue - Main Building, Room 8

CLMPS 2015 PROGRAMME – THURSDAY 6 AUGUST

11:00AM-1:00PM

B5.4 Historical Aspects in the Philosophy of Science
Contributed Papers

Chair
Jouni-Matti Kuukkanen, University of Oulu

The reception of Ludwik Fleck's theory of thought styles and thought collectives in English
Pawel Jarnicki
Collegium Helveticum, ETHZ, Zuerich, SWITZERLAND

Reinvigorating Hanson's patterns of discovery
Sami Paavola
Institute of Behavioural Sciences, University of Helsinki, Helsinki, FINLAND

Lakatos, Rational Reconstruction and Comparative Historiography
Jouni-Matti Kuukkanen
Philosophy, University of Oulu, Oulu , FINLAND

Thomas Kuhn and the rationality of theory choice
Eros Carvalho
Philosophy, UFRGS, Porto Alegre, BRAZIL

Venue - Main Building, Room 17

11:00AM-1:00PM

C1.6 Philosophy of the Formal Sciences
Contributed Papers

Chair
Marianna Antonutti Marfori, IHPST, Université Paris 1 - Panthéon Sorbonne

Why Post did not have Turing's Thesis
Wilfried Sieg, Philosophy, Carnegie Mellon University, Pittsburgh, USA
Mate Szabo, Philosophy, Carnegie Mellon University, Pittsburgh, USA
Dawn McLaughlin, Philosophy, Carnegie Mellon University, Pittsburgh, USA

Squeezing feasibility
Walter Dean
Philosophy, University of Warwick, Coventry, UNITED KINGDOM

Justifying proof-theoretic reflection
Marianna Antonutti Marfori
IHPST, Université Paris 1 - Panthéon Sorbonne, Paris, FRANCE

Venue - Main Building, Room 10

11:00AM-1:00PM

C2.7 Philosophy of the Physical Sciences
Contributed Papers

Chair
Yuichiro Kitajima, Nihon University

A diachronic perspective on the structure of quantum lattices
Sebastian Fortin
Facultad de Ciencias Exactas y Naturales, CONICET-Universidad de Buenos Aires, Ciudad de Buenos Aires, ARGENTINA
Leonardo Vanni
Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Ciudad de Buenos Aires, ARGENTINA

Common cause closedness in orthomodular lattices
Yuichiro Kitajima
College of Industrial Technology, Nihon University, Narashino, JAPAN

Popper School Methodological Disproof of Quantum Logic
Steven Meyer
R&D, Tachyon Design Automation, San Francisco, USA

Generalized Implication in Quantum Logic
Tsuyoshi Yokoo
Philosophy, Keio University, Tokyo, JAPAN

Venue - Main Building, Room 6

11:00AM-1:00PM

C4.3 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
Samuli Pöyhönen, University of Helsinki

What, when, and how do rational analysis models explain?
Samuli Pöyhönen
Social and Moral Philosophy, University of Helsinki, University of Helsinki, FINLAND

The Predictive Coding Model of Dreaming
Sina Fazelpour
Philosophy, University of British Columbia, Vancouver, CANADA

The computer-scientists. About some models of creativity
Monika Chylinska
Department of Theory of Knowledge, John Paul II Catholic University of Lublin, Lublin, POLAND

A general set-theoretical model for the notion of "systemic change" in systemic-relational epistemology and psychology
Salvatore Roberto Arpaia
Human and social sciences, University of Bergamo, Bergamo, ITALY

Venue - Main Building, Room 4

11:00AM-1:00PM

C8.2 Metaphilosophy
Contributed Papers

Chair
Leena Tulkki, University of Helsinki

The Normative Aspect of Naturalistic Philosophy of Science
Leena Tulkki
Department of Philosophy, History, Culture and Art Studies, University of Helsinki, Helsinki, FINLAND

Philosophy is Alive and Well: Who's Afraid of Intertheoretic Reduction?
Dennis Apolega
Philosophy, De La Salle University Manila, Manila, PHILIPPINES

Philosophy as "anything goes": A Critical Analysis of the Problem
Blazej Gebura
Department of Philosophy, John Paul II Catholic University of Lublin, Lublin, POLAND

Can the metaphilosophy of cybersemiotics solve the paradox of transdisciplinary frameworks of Wissenschaft?
Søren Brier
International Business Communication, Copenhagen Business School, Copenhagen, DENMARK

Venue - Main Building, Auditorium IV

11:00AM-1:00PM

The Foundational Significance of Abstract Model Theory
Symposia

On the Theory of Institutions and The Philosophical Significance of Categorical Thinking
Maria Dimarogkona and Petros Stefaneas, National Technical University of Athens

Categorical Representation of Discrete Dynamical Systems Computability
Mark Addis, Birmingham City University

Syntactic Generic Constructions and their Applications
Sergey Sudoplatov
Sobolev Institute of Mathematics, Novosibirsk State Technical University & Novosibirsk State University

Venue - Main Building, Room 12

1:00PM-2:30PM

Lunch
Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with LC 2015) for participants who have purchased the additional lunch package (60,60 €).

Venue - Main Building Unicafe

2:30PM-4:30PM

International Council for Science (ICSU) special session: Future Earth
Special Sessions

Chair
Elliott Sober, University of Wisconsin – Madison

Transformative Research for a Sustainable Future Earth
Gordon McBean
President, International Council for Science / Professor, Western University, London, ON, CANADA

Biodiversity and Triage
Mark Colyvan
University of Sydney, AUSTRALIA

Venue - Main Building, Small Hall

2:30PM-4:30PM

Philosophy of Mathematical Practice II
Affiliated Meetings

Sponsored by the Association for the Philosophy of Mathematical Practice (APMP).

Organized by:
Andrew Arana, University of Illinois
Emily Grosholz, Penn State University
Dirk Schlimm, McGill University

Motivating proofs (14:30 – 15:00)
Rebecca Morris, Carnegie Mellon University

Pluralist mathematical practice (15:00 – 15:30)
Michele Friend, George Washington University

Why 'scaffolding' is the wrong metaphor (15:30 – 16:00)
Brendan Larvor, University of Hertfordshire

Mathematical practice and human cognition. A critical assessment of Quinn's "Science of Mathematics" (16:00 – 16:30)
Bernd Buldt, University of Indiana-Purdue University, Fort Wayne

Venue - Main Building, Auditorium II

2:30PM-4:30PM

A1.2 Mathematical Logic + C1.12 Philosophy of the Formal Sciences
Contributed Papers

Chair
Yurii Khomskii, University of Vienna

On Gödel numbering
Abraham Lim Ken Zhi
Institute of Philosophy of Mind and Cognition, National Yang-Ming University, Taipei, TAIWAN

On the problem of preserving finite axiomatizability of a finite matrix under term-equivalence
Aleksandra Samonek
Logic, Jagiellonian University, Krakow, POLAND

Do infinitely often equal trees add Cohen reals?
Yurii Khomskii
Kurt Gödel Research Center (KGRC), University of Vienna, Vienna, AUSTRIA Giorgio Laguzzi, University of Freiburg, Freiburg, GERMANY

Justifying Deductive Inference Mathieu Beirlaen
Institute for Philosophy II, Ruhr University Bochum, Waregem, BELGIUM

Venue - Main Building, Room 16

2:30PM-4:30PM

A2.13 Philosophical Logic
Contributed Papers

Chair
Sergi Oms, University of Barcelona

The Liar-like paradoxes
Jan Wolenski
Social Sciences, WSIZ, Rzeszow, POLAND

Fuzzy Logic and Sorites Paradox: The Problem of Missing Input
Jan Štepánek
Department of Philosophy, Masaryk University, Brno, CZECH REPUBLIC

A Conditional for Vagueness and the Liar
Sergi Oms
Lògica, Història i Filosofia de la Ciència, Logos, University of Barcelona, Barcelona, SPAIN

Some Remarks on the Cassationist Approach to the Liar Paradox
Jordi Valor Abad
Lògica i Filosofia de la Ciència, Universitat de València, Valencia, SPAIN

Venue - Main Building, Room 14

2:30PM-4:30PM

A2.14 Philosophical Logic
Contributed Papers

Chair
Igor Sedlar, Comenius University in Bratislava

Modal Logics of Abstract Explanation Frameworks
Igor Sedlar
Dept. of Logic and Methodology of Science, Comenius University in Bratislava, Bratislava, SLOVAKIA
Juraj Halas
Dept. of Logic and Methodology of Science, Comenius University in Bratislava, Bratislava, SLOVAKIA

The Import of Formal Logic with Respect to Knowledge – The Fundamental Question of the "Critique of Pure Reason"
Max Gottschlich
Department of Philosophy, University of Warwick, Coventry, UNITED KINGDOM
The Rules of Definition: a Logical and Pragmatic Perspective
Michel Paquette
Philosophy, Collège de Maisonneuve, Montreal, CANADA

First steps towards non-classical logic of informal provability
Pawel Pawlowski
Department of Philosophy, University of Gent, Gent, BELGIUM Rafal Urbaniak, Gent, BELGIUM

Venue - Main Building, Room 15

2:30PM-4:30PM

A2.5 Philosophical Logic
Contributed Papers

Chair
Xunwei Zhou, Beijing Union University

The establishment of mutually inverse implication proposition
Xunwei Zhou
Institute of Information Technology, Beijing Union University, Beijing, CHINA

Dialectic Logic: Mathematical Archeology or Mathematical Technology?
Antonio Vincenzi
Altosner Stiftung für philosophische Grundkagenfor, Altosner Stiftung für philosophische Grundkagenfor, Albissola Mare, ITALY

Type-Theoretical Approaches to Problems and Solutions
Ivo Pezlar
Department of Philosophy, Masaryk University, Brno, CZECH REPUBLIC

Venue - Main Building, Room 8

2:30PM-4:30PM

A3.2 Computational Logic and Applications of Logic
Contributed Papers

Chair
Thomas Meyer, CSIR and UKZN

Belief Revision for Non-Monotonic Knowledge Bases
Thomas Meyer
Centre for AI Research , CSIR and UKZN, Pretoria, SOUTH AFRICA
Giovanni Casini
Philosophy and Centre for AI Research, University of Pretoria and CSIR, Pretoria, SOUTH AFRICA
Emma Ruttkamp-Bloem
Philosophy and Centre for AI Research, University of Pretoria and CSIR, Hatfield, SOUTH AFRICA

On The De-Semantification and Re-Semantification of Deep & Expert Disagreements: Inquiries on Formalization Design and Adequacy Criteria
Luciana Garbayo
Philosophy, University of Texas at El Paso, El Paso, USA

Venue - Main Building, Room 10

2:30PM-4:30PM

A4.4 Historical Aspects of Logic
Contributed Papers

Chair
Marco Ruffino, State University of Campinas (Unicamp)

Philosophical and Mathematical Correspondence between Gottlob Frege and Bertrand Russell in the Years 1902-1904. Some Uninvestigated Topics
Gabriela Besler
Institute of Philosophy, University of Silesia, Katowice, POLAND

A Puzzle About Frege's Singular Senses
Marco Ruffino
Philosophy, State University of Campinas (Unicamp), Campinas, Brazil

Gottlob Frege and the school of Brentano
Yury Chernoskutov
Logic, Saint-Petersburg State University, Saint-Petersburg, RUSSIAN FEDERATION

Chomsky, Wittgenstein, Frege and the Formalists: A Dispute Concerning Meaning
Tamara Dobler
School of Politics, Philosophy and Language, University of East Anglia, Norwich, UNITED KINGDOM

Venue - Main Building, Room 17

2:30PM-4:30PM

B1.5 Methodology
Contributed Papers

Chair
Benjamin Jantzen, Virginia Tech

Re-discovery of the Nature and Logic of Scientific Discovery
Liang Lei
Dept. of Philosophy, Central South University University, Chang Sha, CHINA

Forced Reinterpretation, Incongruity-Resolution and Scientific Discovery
Tim De Mey
Theoretical Philosophy, Erasmus University Rotterdam, Rotterdam, NETHERLANDS

Natural kinds and automated scientific discovery
Benjamin Jantzen
Philosophy, Virginia Tech, Blacksburg, USA

Venue - Main Building, Room 13

2:30PM-4:30PM

B3.5 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
A behavioral analysis of group knowledge and group behavior
Rohit Parikh, CUNY

Naturalness of physical theories and fundamentality of laws
Aldo Filomeno
Philosophy, UAB (previously), Barcelona, SPAIN

A behavioral analysis of group knowledge and group behavior
Rohit Parikh
CS, Math, Philosophy, CUNY, New York, NY, USA

Summarizing the Quantum World: The Universal Wave Function as a Humean Law
Eddy Keming Chen
Philosophy, Rutgers University, New Brunswick, USA

Venue - Main Building, Room 6

2:30PM-4:30PM

C2.8 Philosophy of the Physical Sciences
Contributed Papers

Chair
Kamil Lacina, Jagiellonian University

A PBR-like argument for psi-ontology in terms of protective measurements
Shan Gao
Institute for the History of Natural Sciences, Chinese Academy of Sciences, Beijing, CHINA

Relationalism and Background Independence in Quantum Gravity
Kamil Lacina
Philosophy of Science, Jagiellonian University, Krakow, POLAND

Reconstruction of The Concept of Physical Quantity: An Epistemological Approach to Understand Weak Value
Hajime Sugio
Philosophy (GCARLS), Keio University, Tokyo, JAPAN

The Probability Problem in Everettian Quantum Mechanics Persists
Foad Dizadji-Bahmani
Philosophy, California State University Los Angeles, Los Angeles, USA

Venue - Main Building, Room 5

2:30PM-4:30PM

C4.6 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
Silvia Ivani, Tilburg University

Can Non-Cognitive Values Have a Beneficial Role in the Assessment of Scientific Theories? A case Study of Evolutionary Psychology
Silvia Ivani
Department of Philosophy, Tilburg University, Tilburg, NETHERLANDS

Methodological and philosophical problems of using thought experiments in moral psychology and behavioural sciences
Robin Kopecký
Department of philosophy and history of science , Charles University in Prague, Faculty of Science, Prague, CZECH REPUBLIC

Venue - Main Building, Auditorium IV

2:30PM-4:30PM

C5.4 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
David Teiram UNED

Austrian methodological individualism: from Carl Menger to Friedrich Hayek
Juliana Tigre
Economic Sciences, UFVJM, Teófilo Otoni, BRAZIL

Mises' and Rothbard's Defenses of Praxeology – A Critical Analysis
Alexander Linsbichler
DK The Sciences in Contexts, University of Vienna, Wien, AUSTRIA

Do we need a universalizing paradigm for rational decision-making?
David Teira
Logic, History and Philosophy of Science, UNED, Madrid, SPAIN
Rasmus G. Winther
U. California Santa Cruz, San Francisco, USA

Ontic structural realism and economics: the unwanted gift
Raj Patel
Philosophy, University of Pennsylvania, Philadelphia, USA

Venue - Main Building, Room 4

2:30PM-4:30PM

C6.2 Philosophy of the Applied Sciences and Technology
Contributed Papers

Chair
Vitaly Gorokhov, Institute of Philosophy of the RAS

Galilean technoscience
Vitaly Gorokhov
Philosophy of Technology, Institute of Philosophy of the RAS, Moscow, RUSSIAN FEDERATION

Mode 2 of Knowledge Production and Mixed Techno-Scientific Roots of Computer Science
Vladimir Fedorov
Philosophy, MIPT, Moscow, RUSSIAN FEDERATION

Confucianism and architectural technology in traditional Chinese society
Shanshan Liu
School of Architecture, Tsinghua University, Beijing, CHINA

A Re-Examination of the Relationship Between Science and Technology
Manjari Chakrabarty
Philosophy and Religion, Visva Bharati University, Santiniketan, India

Venue - Main Building, Room 7

2:45PM-5:45PM

A Social Philosophy of Science: An Affiliated Meeting
Affiliated Meetings

Organizer
Ilya Kasavin, Institute of Philosophy

Hegel, Newton and epistemic constructivism
Tom Rockmore, Duquesne University, USA

The Role of Social Scientists: The Diverse Virtues of Social Knowledge
Alexander Ruser, Zeppelin University, Germany

Venue - Main Building, Room 3

4:30PM-5:00PM

Coffee

Venue - Main Building, new side

5:00PM-6:00PM

International Council for Science (ICSU) special session: Future Earth
Special Sessions

Chair
Elliott Sober, University of Wisconsin – Madison

Climate Models and Calibration and Confirmation: The Need for a More Nuanced Picture of Use-Novelty and Double-Counting
Charlotte Werndl, London School of Economics, UNITED KINGDOM

Venue - Main Building, Small Hall

5:00PM-7:00PM

Philosophy of Mathematical Practice III
Affiliated Meetings

Sponsored by the Association for the Philosophy of Mathematical Practice (APMP).

Organized by
Andrew Arana, University of Illinois
Emily Grosholz, Penn State University
Dirk Schlimm, McGill University

Innate Abilities & Algebraic Reasoning (17:00 – 17:30)
Madeline Muntersbjorn

The research mathematician's working tools, cognitive strategies and the training of the mind (17:30 – 18:00)
Norma B. Goethe, National University of Cordoba

From proto-arithmetical to arithmetical (18:00 – 18:30)
Markus Pantsar, University of Helsinki

Philosophy of arithmetic and number cognition: re-assessing the basis of interdisciplinarity (18:30 – 19:00)
Paula Quinon, Lund University

Venue - Main Building, Auditorium II

A2.12 Philosophical Logic
Contributed Papers

Chair
Edoardo Rivello, University of Torino

Generalized Dialetheism and Curry's Paradox
Colin Caret
Underwood International College, Yonsei University, Incheon, SOUTH KOREA

Graphs, naive truth, and well-behaved conditionals
Lorenzo Rossi
Philosophy, University of Oxford, Oxford, UNITED KINGDOM

Saving tolerance from paradox; a game semantics for tolerance
Ali Abasnezhad
Philosophy, University of British Coloumbia , Vancouver, CANADA

A Revision-Theoretic Supervaluational Theory of Truth
Edoardo Rivello
Department of Mathematics, University of Torino, Torino, ITALY

Venue - Main Building, Room 15

A2.15 Philosophical Logic
Contributed Papers

Chair
Rossella Marrano, Scuola Normale Superiore, Pisa

Elementary deductive step and Church's Thesis
Vitali Tselishchev
Logic and epistemology, Institute of philosophy and law of Siberian branch, Novosibirsk, RUSSIAN FEDERATION

The Iterated Prisoner's Dilemma as an Interrogative Game
Levis Zerpa
Social Sciences, Social Sciences, Yachay Tech, San Miguel de Urcuqui, Ecuador

A qualitative perspective on vagueness and degrees of truth
Rossella Marrano
Philosophy, Scuola Normale Superiore, Pisa, Pisa, ITALY

The inapplicability of (selected) paraconsistent logics
Rafal Urbaniak
Department of Philosophy, Ghent University (and Gdansk University), Ghent, BELGIUM

Venue - Main Building, Room 12

A3.3 Computational Logic and Applications of Logic
Contributed Papers

Chair
Tuomo Kauranne, Lappeenranta University of Technology

Granular Mining of Logical Rules from Relational Structures
Churn-Jung Liau
Institute of Information Science, Academia Sinica, Taipei, TAIWAN

Finitely Unstable Theories and Computational Complexity
Tuomo Kauranne
Mathematics and Physics, Lappeenranta University of Technology, Lappeenranta, FINLAND

Bi-Logic Via Infinite Singletons
Giulia Battilotti
Dept. of Mathematics, University of Padova, Selvazzano Dentro (Pd), ITALY

Level system of formulas for decreasing the number of proof steps of formulas simulating some Artificial Intelligence problems
Tatiana Kosovskaya
Faculty of Mathematics and Mechanics, St. Petersburg State University, St. Petersburg, RUSSIAN FEDERATION

Venue - Main Building, Room 17

B1.6 Methodology
Contributed Papers

Chair
Emma Ruttkamp-Bloem, University of Pretoria & CAIR

Explanation by idealized theories
Ilkka Niiniluoto
Department of Philosophy, History, Culture and Art Studies, University of Helsinki, FINLAND

An Interactive Criterion for Realism
Emma Ruttkamp-Bloem
Philosophy, University of Pretoria & CAIR, Pretoria, SOUTH AFRICA

Theory-Progressivism: Between Realism and Anti-Realism
Juha Saatsi
School of PRHS, University of Leeds, Leeds, UNITED KINGDOM

Why Psillos' Purportedly Scientific Argument for Scientific Realism Fails
Reto Gubelmann
Department of Philosophy, University of Zurich, Zürich, SWITZERLAND

Venue - Main Building, Room 13

C1.7 Philosophy of the Formal Sciences
Contributed Papers

Chair
Petros Stefaneas, NTUA

Reference and Invariance in Abstraction Principles
Francesca Boccuni
Philosophy, University Vita-Salute San Raffaele, Milano, ITALY

Characterization of the style of mathematical proving by means of Roman Jakobson's communication model
Petros Stefaneas
Mathematics, NTUA, Athina, GREECE
Ioannis Vandoulakis
Greek Open University, Athina, GREECE

Ampliative Reasoning: The Specificity of Mathematical Language and the Uses of Ambiguity
Emily Grosholz
Department of Philosophy, The Pennsylvania State University, University Park, USA

Polyadic and Higher-Order Abstraction Principles
Beau Madison Mount
Philosophy , Oxford University , Oxford , UNITED KINGDOM

Venue - Main Building, Room 6

C2.9 Philosophy of the Physical Sciences
Contributed Papers

Chair
Tracy Lupher, James Madison University

Is Bose Einstein Condensation of Trapped Gases a Phase Transition?
Marco Corgini
Mathematics, Universidad de la Serena, La Serena, Chile

Are Unitarily Inequivalent Representations in Quantum Field Theory Incommensurable Physical Theories?
Tracy Lupher
Philosophy and Religion, James Madison University, Harrisonburg, USA

Do renormalization group methods explain continuous phase transitions?
Patricia Palacios
Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universität München, Munich, GERMANY

Some Considerations Concerning Bohmian Quantum Field Theories
Emanuele Rossanese
Philosophy, Communication and Visual Arts, University of Roma Tre, Maccarese (Rome), ITALY

Venue - Main Building, Room 5

C3.3 Philosophy of the Life Sciences
Contributed Papers

Chair
Petri Turunen, University of Helsinki

Discovering Mechanisms, Investigating Phenomena, and Experimental Discovery-A New Account of Experimental Practice
Hsiao-Fan Yeh, General Education Center, National Formosa University, New Taipei City, TAIWAN

Venue - Main Building, Room 7

C4.7 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
Jelena Issajeva, Tallinn University of Technology

Mental Imagery as a sign system?
Jelena Issajeva
Ragnar Nurkse School of Governance and Innovation, Tallinn University of Technology, Tallinn, ESTONIA

A Naturalistic Theory of Perceptual Representations
Marc Artiga
Departament de Filosofia, Universitat de Barcelona, Barcelona, SPAIN

Transitivity of visual sameness
Blazej Skrzypulec
Institute of Philosophy, Jagiellonian University, Kraków, POLAND

False Belief Attribution in Early Infancy and Its Neural Correlates
Ayca Mazman
Philosophy, University of Cincinnati, CINCINNATI, USA

Venue - Main Building, Room 16

C5.3 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
Vihren Bouzov, St. Cyril and St. Methodius University Veliko Turnovo

A Decision-Theoretic Approach to Norms and Values
Vihren Bouzov
Philosophy, St. Cyril and St. Methodius University Veliko Turnovo, BULGARIA

Reasons and ''Ought''
Anthony Gambrell
Social and Moral Philosophy, University of Helsinki, Reykjavik, ICELAND

Klein's Geometry and Ethical Theories: Invariances in Equality Spaces
Giulia Pagliani
Department of Social and Economic Sciences , Sapienza University of Rome, Rome, ITALY

Definitory and strategic rules in ethics
Ahti-Veikko Pietarinen
Chair of Philosophy, Tallinn University of Technology, Tallinn, ESTONIA
Juuso-Ville Gustafsson,
Tampere, FINLAND

Venue - Main Building, Room 4

C8.1 Metaphilosophy
Contributed Papers

Chair
Delia Belleri, University of Barcelona

The Epistemology of Modality and the Method(s) of Philosophy
Mihai Rusu
G.Zane Institute for Economic and Social Research, Romanian Academy, Iasi Branch, Iasi, ROMANIA

Philosophy Disputes, Defectiveness and Responsiveness to Reasons
Delia Belleri
Dept. de Lògica, Història i Filosofia de la Ciènci, University of Barcelona, Barcelona, SPAIN

On the difficulties of saying 'what is an inference'
Akos Gyarmathy
Philosophy and History of Science, Budapest University of Technology and Economics, Budapest, HUNGARY
Gabor Forgács
Budapest University of Technology and Economics, Budapest, HUNGARY

Venue - Main Building, Auditorium IV

Must Every Thing Go?
Symposia

Every thing must stay
Mariam Thalos, University of Utah

Some skeptical remarks about ontic structuralism
Matteo Morganti, University of Rome

Structuralism and fundamentality
Tuomas Tahko, University of Helsinki

Dynamical information structures in quantum theory?
Paavo Pylkkänen, University of Helsinki

Venue - Main Building, Room 10

Social mistakes
Symposia

Introduction
Carlo Proietti, Lund University

Virtuous and vicious consensus
Stefan Schubert, London School of Economics

Cascades: Macro and Micro Perspectives
Rasmus Rensdsvig, Lund University

Reflecting on social influence and pluralistic ignorance
Zoé Christoff, University of Amsterdam
Jens Ulrik Hansen, Lund University

Venue - Main Building, Room 14

Tracking the Diagrammatic Turn in Recent Philosophy of Notation
Symposia

Marc Champagne, Philosophy, History, Culture and Art Studies, University of Helsinki, Helsinki, FINLAND
Francesco Bellucci, Philosophy and Communications, University of Bologna, Bologna, ITALY
James Burton, Computing, Engineering and Mathematics, University of Brighton, Brighton UNITED KINGDOM
Frederik Stjernfelt, Arts and Cultural Studies, University of Copenhagen, Copenhagen, DENMARK
Ahti- Veikko Pietarinen, Ragnar Nurkse School of Innovation and Governance, Tallinn University of Technology, Tallinn, ESTONIA

Venue - Main Building, Room 8

6:00PM-8:00PM

DLMPS General Assembly

The Assembly takes place at the congress venue in the Consistory's Hall (the first floor). The Assembly is open to all congress participants. For voting rights and further regulations, please consult the DLMPS statutes: http://www.dlmpst.org/pages/statutes.php

Venue - Main Building Consistory's Hall

FRIDAY 7 AUGUST

9:00AM-10:30AM

Plenary Lecture: Eleanor Knox
Plenary Lectures

Chair
Mari Carla Galavotti, University of Bologna

Spacetime Functionalism
Eleanor Knox
King's College, London, UNITED KINGDOM

Venue - Main Building Great Hall

10:30AM-11:00AM

Coffee

Venue - Main Building, new side

11:00AM-1:00PM

B1. Invited Session: Methodology
Invited Sessions

Chair
Caterina Marchionni, University of Helsinki

From nowhere, from here now, or from there then. A tale of success-to-truth inferences along perspectivalist lines
Michela Massimi
University of Edinburgh, UNITED KINGDOM

Fact, Fiction, and Finance: Methodological Aspects of Econophysics
Dean Rickles
University of Sydney, AUSTRALIA

Venue - Main Building, Room 5

11:00AM-1:00PM

C4. Invited Session: Philosophy of the Cognitive and Behavioural Sciences
Invited Sessions

Chair
Petri Ylikoski, University of Helsinki

The Rewards of Associative Modeling
Cameron Buckner
University of Houston, USA

What is action-oriented perception?
Zoe Drayson
University of Stirling, UNITED KINGDOM

Venue - Main Building, Small Hall

11:00AM-1:00PM

Proof theory of modal and non-classical logics I
Affiliated Meetings

Organized by
Giovanna Corsi, University of Bologna
Sara Negri, University of Helsinki

Using Assumptions in Gentzen-type Systems (11.00–11.30)
Arnon Avron, Tel-Aviv University

Uniform interpolation and proof systems (11.30–12.00)
Rosalie Iemhoff, Utrecht University

Natural deduction for bi-connexive logic (12.00–12.30)
Heinrich Wansing, Ruhr-University Bochum

Mimamsa deontic logic: proof theory and applications (12.30–13.00)
Agata Ciabattoni, Elisa Freschi, Francesco A. Genco, and Bjorn Lellmann
Vienna University of Technology

Venue - Main Building, Room 14

11:00AM-1:00PM

Arabic Logic Commission
Commission Sessions

Organizer
Wilfrid Hodges, Past President, DLMPS

Could Ibn Sina's logic be undecidable? (11.00-11.40)
Maarefi Mohammad IPM, Tehran, IRAN

Al-ʿAllāma al-Ḥillī and the early reception of the Shamsiyya (11.40-12.20)
Tony Street Faculty of Divinity, University of Cambridge, UNITED KINGDOM

Taḥrīf in Medieval Arabic and Persian Logic Texts: A threat to Compositionality? (12.20-13.00)
Joep Lameer Membre Associé, Laboratoire SPHERE, Université Paris Diderot - Paris 7, FRANCE

Venue - Main Building, Room 7

11:00AM-1:30PM

Session of HaPoC (History and Philosophy of Computing) I
Commission Sessions

Organizer
Liesbeth De Mol, Université de Lille 3

Putting Mathematics into the Computer: Implementation and Epistemology in Early Automated Logic
Stephanie Dick, Harvard University

Defining the semantics of proof evidence
Dale Miller, Inria/Saclay and Lix

Formalism and Computations Peter Koepke, University of Bonn

Venue - Main Building, Auditorium IV

11:00AM-1:00PM

A1.3 Mathematical Logic
Contributed Papers

Chair
Carles Noguera, Institute of Information Theory and Automation

Extending the set of variables in propositional logics
Carles Noguera
Decision Making Theory, Institute of Information Theory and Automation, Prague, CZECH REPUBLIC
Petr Cintula
Theoretical Computer Science, Institute of Computer Science, Prague, CZECH REPUBLIC

Residuated lattices with Galois connections as monadic operators
Michiro Kondo
Information Environment , School of Information Environment , Inzai, JAPAN

The Librationist Domination of Second Order Arithmetic
Frode Bjørdal
Philosophy, Classics and History of Art and Ideas, University of Oslo, Oslo, NORWAY

A Constructive Justification of Brouwer's Bar Induction
Ryota Akiyoshi
Faculty of Letters , Kyoto University, Kanagawaken, JAPAN

Venue - Main Building, Room 17

11:00AM-1:00PM

A2.17 Philosophical Logic
Contributed Papers

Chair
Hartley Slater, University of Western Australia

Anderson and Belnap's Confusion
Hartley Slater
Philosophy, University of Western Australia, Perth, AUSTRALIA

Metalogical Decorations of Logical Diagrams
Lorenz Demey
Center for Logic and Analytic Philosophy, KU Leuven, Leuven, BELGIUM
Hans Smessaert
Department of Linguistics, KU Leuven, Leuven, BELGIUM

Notions of relevance for classical logic
Raymundo Morado
Instituto de Investigaciones Filosóficas, UNAM, Mexico City, MEXICO

On the Multiple Advantages of a Certain Uniform Framework for Consequence
João Marcos
DIMAp, UFRN, Natal/RN, BRAZIL Carolina Blasio, Philosophy, UNICAMP, Campinas/SP, BRAZIL

Venue - Main Building, Room 10

11:00AM-1:00PM

A2.18 Philosophical Logic
Contributed Papers

Chair
John Serembus, Widener University

Two Faces of Logical Truths --- Between Ordinary Language and Formal Language
Yang HU
Philosophy, Ecole Normale Superieure de Lyon, Lyon, FRANCE

Which arguments are logically incorrect?
Vladimir Svoboda
Department of Logic, Institute of Philosophy, Prague, CZECH REPUBLIC
Jaroslav Peregrin
Department of Logic, Institute of Philosophy, Prague, CZECH REPUBLIC

'Complete Sets of Logical Functions' Revisited: an examination and reinterpretation of early Functional Completeness proofs of Propositional Logic
John Serembus
Humanities, Widener University, Chester, PA, USA

The Epistemic Significance of Valid Inference – A Model-Theoretic Approach
Constantin Brîncus
Faculty of Philosophy, University of Bucharest, Bucharest, ROMANIA

Venue - Main Building, Room 15

11:00AM-1:00PM

B3.11 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Markus Eronen, KU Leuven

Realism about quantities?
Johanna Wolff
Philosophy, The University of Hong Kong, Hong Kong, HONGKONG

Robustness and Reality: How Science Justifies Ontological Commitments
Markus Eronen
Institute of Philosophy, KU Leuven, Leuven, BELGIUM

Is there a third path: can a scientific realist be a mathematical antirealist?
Laszlo Kocsis
Department of Philosophy, University of Pecs, Pecs, HUNGARY

Towards a counterfactual account of extra-mathematical explanation
John Heron
Philosophy, King's College London, London, UNITED KINGDOM

Venue - Main Building, Room 13

11:00AM-1:00PM

C1.8 Philosophy of the Formal Sciences
Contributed Papers

Chair
Dirk Schlimm, McGill University

Dispensability of Higher-Order in Mathematics
Besim Karakadilar
Philosophy, University of Helsinki, Helsinki, FINLAND

Constructive Axiomatic Method in Euclid, Hilbert and Voevodsky
Andrei Rodin
Institute of Philosophy, Russian Academy of Sciences, Moscow, RUSSIAN FEDERATION

Geometric reasoning and geometric content
Dirk Schlimm
Philosophy, McGill University, Montreal, CANADA

Gödel's Second Incompleteness Theorem Is Predicate Dependent
Alexandr Bessonov
Logic and epistemology, Institute of Philosophy and Law, Novosibirsk, RUSSIAN FEDERATION

Venue - Main Building, Room 6

11:00AM-1:00PM

C2.10 Philosophy of the Physical Sciences
Contributed Papers

Chair
Jaakko Hintikka, Helsinki Collegium for Advanced Studies

Entanglement and Probability
Jaakko Hintikka
Philosophy, Helsinki Collegium for Advanced Studies, University of Helsinki, Helsinki, FINLAND

A discussion about the ontological commitments of quantum information theory
Federico Holik
Facultad de Ciencias Exactas, CONICET-Universidad Nacional de La Plata, La Plata, ARGENTINA
Olimpia Lombardi, Facultad de Ciencias Exactas y Naturales, CONICET-Universidad de Buenos Aires, Buenos Aires, ARGENTINA

A Path Integral Treatment of an EPR Experiment: Insights into the Nature of Quantum Nonlocality?
Brian Padden, Philosophy of Science, LMU Munich, Munich, GERMANY
Separate common causes explanations for EPR-correlations - an almost-no-go result
Michal Tomasz Godziszewski
Department of Logic, University of Warsaw, Warszawa, POLAND
Tomasz Placek
Department of Epistemology, Jagiellonian University, Krakow, POLAND
Leszek Wronski
Department of Epistemology, Jagiellonian University, Krakow, POLAND

Venue - Main Building, Room 12

11:00AM-1:00PM

C2.6 Philosophy of the Physical Sciences
Contributed Papers

Chair
Cristian Lopez, Universidad de Buenos Aires

Information, entanglement and causation
Olimpia Lombardi
Facultad de Ciencias Exactas y Naturales, CONICET-Universidad de Buenos Aires, Ciudad de Buenos Aires, ARGENTINA
Cristian Lopez
Facultad de Filosofia y Letras, Universidad de Buenos Aires, Ciudad de Buenos Aires, ARGENTINA

On the Problem of Truth Valuation in Quantum Mechanics in Light of Category Theory
Vassilios Karakostas
Department of Philosophy and History of Science, University of Athens, Faculty of Sciences, Athens, GREECE
Elias Zafiris
Department of Logic, Eotvos University, Budapest, HUNGARY

Venue - Main Building, Room 8

11:00AM-1:00PM

C6.1 Philosophy of the Applied Sciences and Technology
Contributed Papers

Chair
Sjoerd Zwart, Delft University of Technology

The necessary revision of a topic: the homo faber is not the only animal faber
Ana Cuevas-Badallo
Philosophy, Logic and Aesthetic, University of Salamanca, Salamanca, SPAIN

Analysing Framing in Design Reasoning
Pieter Vermaas
Philosophy, Delft University of Technology, Delft, NETHERLANDS

Projective Simulation and the Taxonomy of Agency
Léon Homeyer
Philosophy, University of Stuttgart, Stuttgart, GERMANY
Giacomo Lini
Institu für Philosophie, University of Stuttgart, Stuttgart, GERMANY

A semantics for technical norms and practical inferences
Peter Kroes
Technology, Policy and Management, Delft University of Technology, Delft, NETHERLANDS
Sjoerd Zwart
Delft University of Technology, Delft, NETHERLANDS,
Maarten Franssen
Delft University of Technology, Delft, NETHERLANDS

Venue - Main Building, Room 16

11:00AM-1:00PM

C7.3 Philosophy of Medicine
Contributed Papers

Chair:
Veli-Pekka Parkkinen, University of Oslo

Measuring the Effectiveness of Medical Interventions
Jacob Stegenga
Philosophy, University Of Utah, Salt Lake City, USA

EBM - a paradigm ready to be challenged
Marie-Caroline Schulte
Philosophy, University of Hamburg, Hamburg, GERMANY

The Fallacy of Simple Extrapolation in Evidence-Based Medicine
Jonathan Fuller
Institute of Medical Science, University of Toronto, Toronto, CANADA

Mechanism-based extrapolation reconsidered
Veli-Pekka Parkkinen
IFIKK, University of Oslo, Oslo, NORWAY

Venue - Main Building, Room 3

11:00AM-1:00PM

Pragmati(ci)st philosophy of Science, Old and New
Symposia

Chiara Ambrosio, Science and Technology Studies, University College London, London, UNITED KINGDOM
Ahti-Veikko Pietarinen, University of Helsinki, Helsinki, FINLAND
Henrik Rydenfelt, University of Helsinki, Helsinki, FINLAND
Mats Bergman, University of Helsinki, Helsinki, FINLAND

Venue - Main Building, Auditorium II

1:00PM-2:30PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with LC 2015) for participants who have purchased the additional lunch package (60,60 €).

Venue - Main Building Unicafe

2:30PM-4:30PM

Special session on CLMPS 2015 conference theme: Models and Modelling
Special Sessions

Chair
Elliott Sober, University of Wisconsin – Madison

Models and Modelling in Formal Epistemology: Some Thoughts on Probability Aggregation
Eleonora Cresto
University of Buenos Aires, ARGENTINA
The National Scientific and Technical Research Council, ARGENTINA

Modelling failure
Uskali Mäki
University of Helsinki, FINLAND

Venue - Main Building, Small Hall

2:30PM-4:30PM

Proof theory of modal and non-classical logics II
Affiliated Meetings

Organized by
Giovanna Corsi, University of Bologna
Sara Negri, University of Helsinki

Unified Correspondence as a Proof-Theoretic Tool (14.30–15.00)
Alessandra Palmigiano, Delft University of Technology

Proof theory for non-classical Euclid's geometrical logic (15.00–15.30)
Pierluigi Graziani, University of Chieti-Pescara

Proof theory for first-order logic of social choice (15.30–16.00)
Paolo Maffezioli, University of Bologna

Proof theory of non-normal modal logics (16.00–16.30)
Eugenio Orlandelli, University of Bologna

Venue - Main Building, Room 14

2:30PM-4:30PM

Session of HaPoC (History and Philosophy of Computing) II
Commission Sessions

Organizer
Liesbeth De Mol, Université de Lille 3

The Church-Turing Theses
Oron Shagrir, University of Jerusalem

TBA
John Symons, University of Kansas

Competing Claims to Computing as a Discipline
Matti Tedre, Stockholm University

Venue - Main Building, Auditorium IV

2:30PM-4:30PM

Joint Commission: Contributed Papers 1
Commission Sessions

Chair
Arnaud Mayrargue, CNRS/SPHERE

Descartes and mathesis universalis - the rise of the modern algebra
Jaakko Joutsi
Department of Social Sciences and Philosophy, University of Jyväskylä, Palokka, SUOMI

A note on the role of physical reasoning in Ptolemy's mathematical astronomy
Anastasia Itokazu
Centro de Ciências Naturais e Humanas, Universidade Federal do ABC, Santo André, BRAZIL

Lyons, Kepler, and the commitments of deployment realism
Mario Alai
Department of Basic Sciences and Foundations, University of Urbino Carlo Bo, Cesena, ITALY

D'Alembert's doubts
Arnaud Mayrargue,
History of Science, CNRS/SPHERE, Paris, FRANCE

Venue - Main Building, Room 8

2:30PM-4:30PM

A2.19 Philosophical Logic
Contributed Papers

Chair
Alberto Mura, Università degli studi di Sassari

Applied ontology, logical pluralism, and the logical constants
Oliver Kutz
Institute for Knowledge and Language Engineering, University of Magdeburg, Magdeburg, GERMANY
Stefano Borgo
Laboratory for Applied Ontology, CNR, Povo (TN), ITALY

Sharpening Logical Independence
Alberto Mura
Dipartimento di Storia e Scienze dell'Uomo, Università degli studi di Sassari, Sassari, ITALY

Designated Operator Theory and Domain of Symbol Expressions
Sergey Pavlov
Epistemology and Logic, Institute of Philosophy , Moscow, RUSSIAN FEDERATION

Hypo: A Deduction-Theoretical Semantics for Heyting's Propositional Logic (HPL)
Wagner Sanz
Philosophy, UFG/CNPq, Goiania, BRAZIL

Venue - Main Building, Room 6

2:30PM-4:30PM

A2.20 Philosophical Logic
Contributed Papers

Chair
Claudio Mazzola, The University of Queensland

Product Update for Dynamified Deontic Logic of Speech Acts
Tomoyuki Yamada
Philosophy, Hokkaido University, Sapporo, JAPAN

Justice-Based Responsibility
Andrzej Malec
Department of Law, S.Staszic College of Public Administration, Bialystok, POLAND

Temporal Enclosure Structures
Claudio Mazzola
School of HPRC, The University of Queensland, Brisbane St Lucia, AUSTRALIA

Future contingents, partial models and the flow of time
Guillaume Massas
Philosophy, Ecole Normale Supérieure / ILLC, Paris, FRANCE

Venue - Main Building, Room 7

2:30PM-4:30PM

A2.7 Philosophical Logic
Contributed Papers

Chair
Mircea Dumitru, University of Bucharest

Grades of specifiability
Costas Dimitracopoulos
History and Philosophy of Science, University of Athens, Athens, GREECE

A Free Logic for Fictionalism
Mircea Dumitru
Philosophy, University of Bucharest, Bucharest, ROMANIA

Why Is There Something Rather Than Nothing? A Logical Investigation
Jan Heylen
Institute of Philosophy, KU Leuven, Leuven, BELGIUM

Speaking of Essence
Alessandro Torza
Instituto de Investigaciones Filosóficas, UNAM, México DF, MEXICO

Venue - Main Building, Room 3

2:30PM-4:30PM

A4.3 Historical Aspects of Logic
Contributed Papers

Chair:
Simo Knuuttila, Helsinki Collegium for Advanced Studies

Individual Names and Identification in Late Medieval Epistemic Logic
Simo Knuuttila
Helsinki Collegium for Advanced Studies, University of Helsinki, Helsinki, FINLAND

John Foxholes's Tractatus de propositione per se nota. Reconstructing the scotistic debate on the status of axioms

Benno van Croesdijk
Philosophy, University of Notre Dame, South Bend, USA

Descartes' Logic and the Paradox of Deduction
Alan Nelson
Philosophy, University of North Carolina, Chapel Hill, USA

Kant's Influence on the Herbartian Conception of Logic
Risto Vilkko
Philosophy, University of Helsinki, Helsinki, FINLAND

Venue - Main Building, Room 17

2:30PM-4:30PM

B1.7 Methodology
Contributed Papers

Chair
Radin Dardashti, Munich Center for Mathematical Philosophy

The No Alternative Argument and the Problem of Establishing Non-empirical Evidence
Radin Dardashti
Philosophy of Science, Munich Center for Mathematical Philosophy, LMU, Munich, GERMANY

Induction and ceteris paribus clause
Adam Grobler
Philosophy, Opole University, Opole, POLAND

Unconceived alternatives and expected unification: a limitation of Stanford's "new induction"
Ioan Muntean
The Reilly Center, University of Notre Dame, Notre Dame, USA

The New Riddle of Induction and the New Riddle of Deduction
Gal Yehezkel
Department of Liberal Arts and Sciences, The Sapir Academic College, D.N. Hof Ashkelon, ISRAEL

Venue - Main Building, Room 13

2:30PM-4:30PM

B3.7 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Alessandra Melas, University of Sassari

The Multi-Storey Humean Mosaic and the Emergence of Objective Probability
Alexander Franklin
Philosophy, King's College London, London, UNITED KINGDOM

Randomness and coincidences: a strong overlap between them
Alessandra Melas
Storia, Scienze dell'Uomo e della Formazione, University of Sassari, Sassari, ITALY

Intelligent Design, Methodological Naturalism and Scientific Reasoning
Juuso Loikkanen
School of Theology, University of Eastern Finland, Joensuu, FINLAND

Against a monistic view of information – Information in biological and physical contexts
Cristian Ariel López
Philosophy, University of Buenos Aires, Ciudad Autónoma de Buenos Aire, ARGENTINA
María José Ferreira Ruiz
Philosophy, University of Buenos Aires - CONICET, Ciudad Autónoma de Buenos Aire, ARGENTINA

Venue - Main Building, Room 12

2:30PM-4:30PM

C1.9 Philosophy of the Formal Sciences
Contributed Papers

Chair
Masaki Harad, Seisen University

Philosophy of logical practice: a case study in formal semantics
Nikhil Maddirala
Strategy and Operations, Deloitte, Hyderabad, INDIA

Philosophy of Operator Algebra: Understanding of Infinite through Algebraic Structure and Dynamics
Masaki Harad
Literature, Seisen University, Tokyo, JAPAN

Set existence principles in reverse mathematics
Benedict Eastaugh
Philosophy, University of Bristol, Bristol, UNITED KINGDOM

Circularity and meaning: a version of logical pluralism
Pilar Terrés Villalonga
Lògica, història i filosofia de la ciència, Universitat de Barcelona - LOGOS, Barcelona, SPAIN

Venue - Main Building, Room 10

2:30PM-4:30PM

C2.11 Philosophy of the Physical Sciences
Contributed Papers

Chair
Erez Firt, Haifa University

Irreversibility and Teleology in Physics
Erez Firt
Philosophy, Haifa University, Tel Aviv, ISRAEL

Quantum mechanics (QM) and the troubles with identity
Décio Krause
Philosophy, Federal University of Santa Catarina, Florianópolis, BRAZIL

Can analogies make us understand quantum mechanics – finally ?
Louis Vervoort
CIRST , University of Quebec at Montreal (UQAM), Montréal, Québec, CANADA

The Equivalence Principle is a Criterion of Identity
Ryan Samaroo
Department of Philosophy, University of Bristol, Bristol, UNITED KINGDOM

Venue - Main Building, Room 5

2:30PM-4:30PM

C5.5 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
Anton Donchev, New Bulgarian University

Applying Confirmation Theory to the Case Against Neurolaw
Anton Donchev
Philosophy and Sociology, New Bulgarian University, Sofia, BULGARIA

Scientific Criteria of Humanitarian Knowledge and Structure of Theory of Law
Igor Nevvazhay
Philosophy, Saratov State Law Academy, Saratov, RUSSIAN FEDERATION

Economy and the Comparative Method: Justifying Phylogenetic Inferences in Historical Linguistics
Emi Okayasu
Philosophy, University of Wisconsin-Madison, Madison, USA

On the Assumptions Required for the Automated Discovery of Theoretical Entities
Erich Kummerfeld
Philosophy, Carnegie Mellon University, Pittsburgh, USA

Venue - Main Building, Room 16

2:30PM-4:30PM

Feyerabend's Theoretical Pluralism vs. Popper's Critical Rationalism Continuities and Ruptures
Symposia

Feyerabend and Popper on Theory Proliferation and Anomaly Import
Karim Bschir, ETH Zürich

A Sorcerer's Apprentice or How Feyerabend Transmuted Critical Rationalism into

Theoretical Pluralism and Got Cursed with Incommensurability
Matteo Collodel, Humboldt-Universität zu Berlin

Feyerabend and Popper on Progress and the Aim of Science
Luca Tambolo, Università di Trieste

How Feyerabend's Theoretical Pluralism Is Incompatible with Popper's Critical Rationalism
Eric Oberheim, Bielefeld Universität

Venue - Main Building, Room 15

2:30PM-4:30PM

Mathematical beauty: A challenge for empirically informed philosophy of mathematics
Symposia

Organizer
Dirk Schlimm, McGill University

Diversity in proof appraisal
Matthew Inglis and Andrew Aberdein

Beauty in the eyes of the beholder? Approaching mathematical beauty in an empirically–informed way
Catarina Dutilh Novaes

Approaches to mathematical aesthetic
Marcus Giaquinto

There is no beauty there
Manya Raman-Sundström

Venue - Main Building, Auditorium II

4:30PM-5:00PM

Coffee

Venue - Main Building, new side

5:00PM-6:00PM

A4. Invited Session: Historical Aspects of Logic
Invited Sessions

Chair
Catarina Dutilh Novaes, University of Groningen

Intensional logic before Leibniz
Paul Thom
The University of Sydney, AUSTRALIA

Venue - Main Building, Room 5

5:00PM-6:00PM

C2. Invited Session: Philosophy of the Physical Sciences
Invited Sessions

Chair
Dennis Dieks, Utrecht University

The quantum origin of statistical-mechanical probability
David Wallace, University of Oxford, UNITED KINGDOM

Venue - Main Building, Small Hall

5:00PM-6:30PM

Proof theory of modal and non-classical logics III
Affiliated Meetings

Organized by
Giovanna Corsi, University of Bologna
Sara Negri, University of Helsinki

Internal and External Calculi for conditional logics (17.00–17.30)
Nicola Olivetti, Aix-Marseille University

Labelled sequent calculi for substructural logics I: Relevant logics (17.30–18.00)
Hidenori Kurokawa, University of Helsinki

Proof theory for neighborhood semantics (18.00–18.30)
Sara Negri, University of Helsinki

Venue - Main Building, Room 14

5:00PM-7:00PM

Session of HaPoC (History and Philosophy of Computing) III
Commission Sessions

Organizer
Liesbeth De Mol, Université de Lille 3

Using History to Make Software More Tangible
Edgar Daylight, Universiteit Utrecht

How do we know that a statement true in Computer Science?
Gilles Dowek, Inria/Deducteam and Mooc Lab

+ Closing Discussion

Venue - Main Building, Auditorium IV

5:00PM-7:00PM

Joint Commission: Contributed Papers 2
Commission Sessions

Chair
José Diez

The (non-Newtonian) conception of time in Hume and Einstein: Similarities and Differences
Matias Slavov
Social Sciences and Philosophy, University of Jyväskylä, Jyväskylä, FINLAND

What happened to phlogiston? Reconsidering the Chemical Revolution
Wayne Myrvold
Philosophy, The University of Western Ontario, London, ON, CANADA

On Richard Cantillon, Or How the Economic Science Has Acquired Its Method and Methodology
Oleg Ananyin
Department of Theoretical Economics, Higher School of Economics, Nat.Research University, Moscow, RUSSIAN FEDERATION

Charles Darwin and Sir John F. W. Herschel: Nineteenth-Century Science and its Methodology
Charles Pence
Philosophy and Religious Studies, Louisiana State University, Baton Rouge, LA, USA

Venue - Main Building, Room 8

5:00PM-7:00PM

A2.21 Philosophical Logic
Contributed Papers

Chair
Jiri Raclavsky, Masaryk University Brno

The Quantified Argument Calculus and Natural Language
Hanoch Ben-Yami
Philosophy, Central European University, Budapest, HUNGARY

Games and the pragmatics of quantifier scope disambiguation
Mihai Hîncu
G. Zane Institut for Economics and Social Research, Romanian Academy, Iasi Branch, Iasi, ROMANIA

An explication of the concept EXPLICATION in the framework of hyperintensional logic
Jiri Raclavsky
Philosophy, Masaryk University Brno, Brno, CZECH REPUBLIC

Venue - Main Building, Room 6

5:00PM-7:00PM

B1.8 Methodology
Contributed Papers

Chair
Raphael Scholl, University of Pittsburg

Truth re-nomination and the Lotka-Volterra-model
Tim Räz
Philosophy, University of Konstanz, Konstanz, GERMANY
Raphael Scholl
Pittsburgh Center for Philosophy of Science, Pittsburgh, USA

Philosophical Models - Their Structure and Function
Lukáš Bielik
Department of Logic and Methodology of Sciences, Comenius University in Bratislava, Bratislava, SLOVAKIA

Manipulationist Account and Unificationist Model
Wei Wang
Institute of Science, Technology and Society, Tsinghua University, Beijing, CHINA
Chuang Liu
Department of Philosophy, Shanxi University & University of Florida, Gainesville, USA

Scientific Modeling and Fictionalism
Chuang Liu
Philosophy, Shanxi University & University of Florida, Gainesville, USA
Wei Wang, Institute of Science, Technology, and Society, Tsinghua University, Beijing, CHINA

Venue - Main Building, Room 13

5:00PM-7:00PM

B2.6 Formal Philosophy of Science and Formal Epistemology
Contributed Papers

Chair
Aránzazu San Ginés Ruiz, Universidad de Granada

I believe successfully ergo I know: A quest for lasting and successful belief
Rohit Parikh
Computer Science, The City University of New York, New York, USA
Aránzazu San Ginés Ruiz
Filosofía 1, Universidad de Granada, Granada, SPAIN

Learning Credences and Betting Credences
Olav Vassend
Philosophy, University of Wisconsin -- Madison, Madison, USA

On the equivalence of various forms of learning in a probabilistic setting
Balazs Gyenis
Institute of Philosophy, Hungarian Academy of Sciences, Budapest, HUNGARY

Venue - Main Building, Room 15

5:00PM-7:00PM

B3.6 Metaphysical Issues in the Philosophy of Science
Contributed Papers

Chair
Ilkka Pättiniemi, University of Helsinki

Ontic Structural Realism and Natural Necessity
William Kallfelz
Philosophy and Religion, Nississippi State University, Mississippi State, USA

Scientific Structuralism Does Not Necessitate Modal Realism
Ilmari Hirvonen
Department of Philosophy, History, Culture and Art Studies, University of Helsinki, Helsinki, FINLAND
Ilkka Pättiniemi
Department of Philosophy, History, Culture and Art Studies, University of Helsinki, Helsinki, FINLAND

Structural Realism without Metaphysics; Notes on Carnap's reinvention of Ramsey-sentence approach
Majid Davoody Beni
Philosophy of science, AmirKabir University of technology, SPER, Tehran, IRAN

An essentialist interpretation of Ontic Structural Realism
Tomasz Bigaj
Philosophy, University of Warsaw, Warsaw, POLAND

Venue - Main Building, Room 12

5:00PM-7:00PM

B4.4 Ethical and Political Issues in the Philosophy of Science
Contributed Papers

Chair
Anna Leuschner, Karlsruhe Institute of Technology

Can Dissent in Science be Epistemically Detrimental? Notes on a Recent Debate
Anna Leuschner
Inst. f. Technology Assessment & Systems Analysis, Karlsruhe Institute of Technology, Karlsruhe, GERMANY

How (not) to make philosophical proposals about social organisation of science
Jaana Eigi
Philosophy, University of Tartu, Tartu, ESTONIA

Defining, quantifying, and assessing diversity in science
Rico Hauswald
Philosophy, Dresden University of Technology, Dresden, GERMANY

The epistemology-metaphysics relationship in Helen Longino's philosophy of science and its consequences for social criticism
Ágnes Kovács
Department of Gender Studies, Central European University, Budapest, HUNGARY

Venue - Main Building, Room 3

5:00PM-7:00PM

B5.2 Historical Aspects in the Philosophy of Science
Contributed Papers

Chair
Thomas Uebel, University of Manchester

Franz Roh as the missing link between Rudolf Carnap and Otto Neurath
Christian Damboeck
Institute Vienna Circle, University of Vienna, Vienna, AUSTRIA

Schlick and Wittgenstein: The Theory of Affirmations Revisited
Thomas Uebel
Philosophy, University of Manchester, Manchester, UNITED KINGDOM

Cassirer, Kaila, and "Helsinki Realism"
Matthias Neuber
Philosophy, University of Tübingen, Tübingen, GERMANY

Revisiting Lakatos's Criticism of Carnapian Inductive Logic
Teddy Groves
Philosophy, University of Kent, Rochester, UNITED KINGDOM

Venue - Main Building, Auditorium II

5:00PM-7:00PM

C1.10 Philosophy of the Formal Sciences
Contributed Papers

Chair
Fedde Benedictus, Utrecht University

Jerzy Neyman on Sampling and Experimentation - Parallels to Bayesian Rationale
Adam Kubiak
Department of Theory of Knowledge, The John Paul II Catholic University of Lublin, Lublin, POLAND
Piotr Lipski
The John Paul II Catholic University of Lublin, Lublin, POLAND

Varieties of Frequentism
Fedde Benedictus
Beta department, Utrecht University, Utrecht, NETHERLANDS

On the explanation of linkedness of Kolmogorov's requirements to probabilities
Vladimir Reznikov
Department Logic and Epistemology, Institute of Philosophy and Law of the SB RAS, Novosibirsk, RUSSIAN FEDERATION

Venue - Main Building, Room 10

5:00PM-7:00PM

C3.4 Philosophy of the Life Sciences
Contributed Papers

Chair
Tilmann Massey, LMU Munich

The natural origins of value
Cristian Saborido
Dpt. Logic, History and Philosophy of Science, UNED, Madrid, SPAIN
Javier Gonzalez de Prado
UNED, Madrid, SPAIN

Did Machiavellian Thinking Shape the Reflective Mind?
Yuichi Amitani
Business Sciences and Regional Development, Tokyo University of Agriculture, Abashiri, JAPAN

Endless Forms in Endless Environments: Multi-Level Selection in Light of Darwin's Ecological Ideas
Tilmann Massey
Logic and Philosophy of Science, LMU Munich, Munich, GERMANY

Two Kinds of Group Level Interactions in Trait Group Selection
Tomi Kokkonen
Philosophy, University of Helsinki, Helsingin yliopisto, FINLAND

Venue - Main Building, Room 17

5:00PM-7:00PM

C5.6 Philosophy of the Humanities and the Social Sciences

Contributed Papers

Chair
Ivan F. da Cunha, Universidade Estadual de Maringá

Karl Popper on Science of Society: A Refutation of Historicism
Oseni Afisi
Philosophy, Lagos State University, Lagos, NIGERIA

On Isaiah Berlin's Methodological Dualism Between the Natural Sciences and the Humanities
Luca Demontis
Philosophy, Scuola Internazionale di Alti Studi, Modena, ITALY

Utopia and Scientism: Neurath and Social Planning
Ivan F. da Cunha
Philosophy, Universidade Estadual de Maringá, Maringá - PR, BRAZIL

Venue - Main Building, Room 16

5:00PM-7:00PM

Computational Finitism and Concrete Foundations of Mathematics

Symposia

Organized by
Marek Czarnecki, Warsaw University
Marcin Mostowski, Warsaw University

Concrete mathematics -- finitistic approach to foundations of mathematics
Marek Czarnecki, Warsaw University
Marcin Mostowski, Warsaw University, Warszawa and Jagiellonian University
(To be presented by Marcin Mostowski)

Concrete model theory. Model-theoretic constructions without actual infinity
Marek Czarnecki, Warsaw University
(To be presented by Michał Tomasz Godziszewski)

An infinite liar in a potentially infinite world
Michał Tomasz Godziszewski, Warsaw University

Learnability thesis, FM--representability and low models of WKL_0
Marek Czarnecki, Warsaw University
Michał Tomasz Godziszewski, Warsaw University
Dariusz Kalociński, Warsaw University

Venue - Main Building, Room 7

7:30PM-8:30PM

Congress Dinner

Social Events

The congress dinner is served at the Restaurant Bank, conveniently located a few blocks away from the congress venue the Main Building of the University of Helsinki. The dinner quests a treated to a three course meal in the functionalist-style old bank building with unique wall paintings and ornaments. Restaurant Bank focuses on modern Finnish cuisine prepared from the best seasonal ingredients.

The Congress Dinner requires online preregistration. The price of the dinner is 50 € (incl. three courses and accompanying wines).

There might be some extra dinner tickets for sale at the Congress Office during the first congress days.

Venue - Restaurant Bank

CLMPS 2015 PROGRAMME – FRIDAY 7 AUGUST

SATURDAY 8 AUGUST

10:00AM-12:00PM

Models and Empirical Philosophy: A Session in Honor of Patrick Suppes

Special Sessions

This session pays homage to the memory of Patrick Suppes (March 17, 1922 - November 17, 2014) who made substantial contributions not only to logic and philosophy of science, but to many other fields including physics, psychology, the social sciences, linguistics, probability and statistics. Thanks to his dual militancy as philosopher and applied scientist working in meteorology, learning theory and neuroscience, Suppes forged a novel way of doing philosophy of science that combines sophisticated formalism and careful attention to the details characterizing research within specific disciplines. A pioneer of the semantic view of theories, Suppes embraced a model-centred approach which is a unique blend of empiricism and pragmatism, revolving around the idea that scientific knowledge has an irreducibly tentative and local character, and is to be analysed from a genuinely pluralistic perspective.

Chair
Maria Carla Galavotti, University of Bologna

Patrick Suppes and the Philosophy of Data Science
Colleen Crangle
Stanford University, USA

Pat Suppes : from logic to probabilistic metaphysics
Anne Fagot-Largeault
The Collège de France, FRANCE

Venue - Main Building, Small Hall

10:00AM-11:00AM

Joint Commision Invited Lecture: International Union of History and Philosophy of Science (IUHPS)

Commission Sessions

Chair
Pablo Lorenzano, National University of Quilmes/CONICET

Prospects for an Integrated History and Philosophy of Composition
Chang Hasok
University of Cambridge, UNITED KINGDOM

Venue - Main Building, Room 5

10:00AM-12:00PM

A2.22 Philosophical Logic

Contributed Papers

Chair
Paolo Pistone, Università Roma Tre/Université Aix-Marseille

Constructive Validity and Admissibility
Inkyo Chung
Philosophy, Korea University, Seoul, SOUTH KOREA

Untyped validity: from interaction to rules
Mattia Petrolo
Philosophy, IHPST - Université Paris 1, Paris, FRANCE
Paolo Pistone
Università Roma Tre/Université Aix-Marseille, Roma, ITALY

On Dummett's Verificationist Justification Procedure
Hermógenes Oliveira
Faculdade de Filosofia, Universidade Federal de Goiás, Goiânia, BRAZIL
Wagner Sanz
Faculdade de Filosofia, Universidade Federal de Goiás, Goiânia, BRAZIL

Completeness results in proof-theoretic semantics and the treatment of negation
Thomas Piecha
Department of Computer Science, University of Tübingen, Tübingen, GERMANY

Venue - Main Building, Room 6

10:00AM-12:00PM

A4.5 Historical Aspects of Logic

Contributed Papers

Chair
Kordula Swietorzecka, Cardinal Stefan Wyszynski University

Anton Marty and the semantics of names
Tuomo Aho
Department of Philosophy, History, Culture and Art Studies, University of Helsinki, University of Helsinki, FINLAND

Leon Chwistek (1884-1944) and his Constructive Type Theory
Hubert Bozek
Institute of Philosophy and Sociology, Pedagogical University of Cracow, Kraków, POLAND

On some unknown ideas by Sobocinski: comments on philosophical applications of Lesniewski's systems
Kordula Swietorzecka
Logic, Cardinal Stefan Wyszynski University, Warsaw, POLAND
Marek Porwolik
Methodology of Science, Cardinal Stefan Wyszynski University, Warsaw, POLAND

Gentzen's 'Finitist' Interpretation in the Context of the Formalism-Intuitionism Controversy
Yuta Takahashi
Faculty of Letters, Keio University, Tokyo, JAPAN

Venue - Main Building, Room 17

10:00AM-12:00PM

B2.4 Formal Philosophy of Science and Formal Epistemology

Contributed Papers

Chair
Francesca Pero, University of Florence

The Inference to the Best Explanation: The Problem of the Description of Evidence to be Explained
Marcos Rodrigues da Silva
Philosophy, UEL, Londrina, BRAZIL

A dialogic approach to abduction
Antonio Duarte Calvo
Logic and Philosophy of Science, Universidad Complutense de Madrid, Madrid, SPAIN

Representation and reconceptualization: the role of structures
Francesca Pero
Philosophy, University of Florence, Florence, ITALY
Tarja Knuuttila
Philosophy, University of South Carolina, Columbia, USA
Elena Castellani
Philosophy, University of Florence, Florence, ITALY

Varieties of Misrepresentation and Homomorphism
Mauricio Suárez
Institute of Philosophy, School of Advanced Study, London, UNITED KINGDOM
Francesca Pero
Philosophy, University of Florence, Florence, ITALY

Venue - Main Building, Room 8

10:00AM-12:00PM

B3.8 Metaphysical Issues in the Philosophy of Science

Contributed Papers

Chair
Pentti Määttänen, University of Helsinki

Pragmatic realism and truth as correspondence
Pentti Määttänen
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

Alethic Pluralism and Scientific Truth
Marco Marletta
Humanities, University of Palermo, Palermo, ITALY

Does Hacking get the most out of his microscopes?
Alexander Aylward
History and Philosophy of Science, University of Cambridge, Cambridge, UNITED KINGDOM

Indeterminacy and Inequivalence
Iulian Toader
Theoretical Philosophy, University of Bucharest, Bucharest, ROMANIA

Venue - Main Building, Room 12

10:00AM-12:00PM

B4.1 Ethical and Political Issues in the Philosophy of Science
Contributed Papers

Chair
Benoit Gaultier, University of Helsinki

Peirce on belief and explanatory hypotheses
Benoit Gaultier
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

Science and Wishful thinking
Ondrácek Tomáš
Philosophy, Masaryk University, Brno, CZECH REPUBLIC

Venue - Main Building, Room 3

10:00AM-12:00PM

C1.11 Philosophy of the Formal Sciences
Contributed Papers

Chair
Zeynep Soysal, Harvard University

A behavioral analysis of group knowledge and group behavior
Rohit Parikh
CS, Math, Philosophy, CUNY, New York, NY, USA

Mathematical knowledge as social knowledge
Sofia Xanthopoulou
Philosophy, Logic and Scientific Method, London School of Economics and Political Science, London, UNITED KINGDOM

Analyticity in Formal Systems
Zeynep Soysal
Philosophy, Harvard University, Cambridge, USA

Venue - Main Building, Room 10

10:00AM-12:00PM

C1.5 Philosophy of the Formal Sciences
Contributed Papers

Chair
Gabriel Sandu, University of Helsinki

“Visualisations in Mathematical Practice and Formation of New Concepts”
Irina Starikova
Philosophy, University of San Paulo, São Paulo, BRAZIL

Can alethic arguments for consistency transmit justification?
Daniel Waxman
Philosophy, New York University, New York, USA

Venue - Main Building, Room 7

10:00AM-12:00PM

C4.5 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
Chiara Lisciandra, University of Helsinki

Motleys, Capacities, and the Mark of the Cognitive
Eric Arnau
Department of Philosophy, Universitat Autonoma de Barcelona, Bellaterra, SPAIN

The explanatory payoffs of the thesis of multiple realization in cognitive neuroscience
Maria Serban
Center for Philosophy of Science, University of Pittsburgh, Pittsburgh, USA

Venue - Main Building, Room 14

10:00AM-12:00PM

C5.10 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
Matti Heinonen, University of Helsinki

The Diffusion of Scientific Theories: Network Topologies and the Role of the Translator
Catherine Herfeld
Philosophy, Munich Center for Mathematical Philosophy, Munich, GERMANY
Malte Döhne
Sociology, Zeppelin University Friedrichshafen, Friedrichshafen, GERMANY

A Model-Based Approach to Shared Agency
Matti Heinonen
Dept of Political and Economic Studies, University of Helsinki, FINLAND

Team reasoning, framing and Frege cases
Olle Blomberg
Center for Subjectivity Research, University of Copenhagen, Copenhagen S, DENMARK

Venue - Main Building, Room 15

10:00AM-12:00PM

C5.7 Philosophy of the Humanities and the Social Sciences
Contributed Papers

Chair
Peter Caws, George Washington University

On the Relevance of Doing Ontology in the Philosophy of the Social Sciences
Simon Lohse
Institute of Philosophy, Leibniz Universitaet Hannover, Hannover, GERMANY

Phenomenological Constructivism in the Social Sciences and Vyacheslav Stepin’s Concept of Civilization Development
Natalia Smirnova
Institute of Philosophy, Russian Academy of sci , Moscow, RUSSIAN FEDERATION

Ontologies of the natural and human sciences
Peter Caws
Philosophy, George Washington University, Washington, DC, USA

Husserl ́s Idea of Rigorous Science and its Relevance for the Human and Social Sciences
Victor Eugen Gelan
Philosophy, Academia Romana Iasi, Iasi, ROMANIA

Venue - Main Building, Room 16

10:00AM-12:00PM

C8.3 Metaphilosophy
Contributed Papers

Chair
Hanne Appelqvist, University of Helsinki

Carnap’s Radical Way Out
Richard Creath
School of Life Sciences, Arizona State University, Tempe, Arizona, USA

Carnap’s Metaphilosophy
André Carus
Philosophy, Hegeler Institute, Chicago, USA
Carnap, Cassirer, Schrödinger and the Hypothesis P
Sirkku Ikonen
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

Wittgenstein on the Impossibility of Illogical Thought
Hanne Appelqvist
Finnish Center of Excellence on Reason and Religious Recognition, University of Helsinki, University of Helsinki, FINLAND

Venue - Main Building, Auditorium II

10:00AM-12:00PM

Foundations of Defeasible Reasoning
Symposia

Organized by
Mathieu Beirlaen and Christian Straßer
Ruhr-University Bochum

Cognitive foundations of defeasible reasoning
Niki Pfeifer, LMU Munich

Formal Properties of Default-Based Inference
G. Aldo Antonelli, University of California

Argumentation as an alternative approach for defeasible reasoning
Leila Amgoud, IRIT, Université Paul Sabatier

Venue - Main Building, Auditorium IV

10:00AM-12:00PM

Investigations into the Meaning of Logical Connectives
Symposia

Reassessing the Quinean challenge
Patrick Allo, Free University of Brussels

Displaying model theory
Luis Estrada-González, National Autonomous University of Mexico

Structuralism vs intra-theoretic pluralism
Francesco Paoli, University of Cagliari

Venue - Main Building, Room 13

12:00PM-1:30PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with LC 2015) for participants who have purchased the additional lunch package (60,60 €).

Venue - Main Building Unicafe

1:30PM-3:30PM

C1. Invited Session: Philosophy of the Formal Sciences
Invited Sessions

Chair
Wilfrid Hodges

Explanation in Mathematics
Mark Colyvan,
University of Sydney, AUSTRALIA

Three degrees of Imprecise Probability [IP] Theory
Teddy Seidenfeld
Carnegie Mellon University, USA

Venue - Main Building, Small Hall

1:30PM-2:30PM

C5. Invited Session: Philosophy of the Humanities and the Social Sciences
Invited Sessions

Chair
Kristina Rolin, University of Helsinki

Scaffolding and Bootstrapping: How Archaeological Evidence Bites Back
Alison Wylie
Departments of Philosophy and Anthropology, University of Washington, UNITED STATES
Department of Philosophy, Durham University, UNITED KINGDOM

Venue - Main Building, Room 5

2:30PM-3:30PM

C8. Invited Session: Metaphilosophy
Invited Sessions

Chair
Uskali Mäki, University of Helsinki

Intuition and Replication
Jennifer Nagel
University of Toronto, Toronto, CANADA

Venue - Main Building, Room 5

1:30PM-3:30PM

Joint Commission: Contributed Papers 3
Commission Sessions

Chair
Jean Gayon, Université Paris 1 Panthéon-Sorbonne

Models of Data, Theoretical Models and Structural Relationships in the History of Genetics
Pablo Lorenzano
Department of Social Sciences, National University of Quilmes/CONICET, Bernal, Prov. Buenos Aires, ARGENTINA

What did the "Rediscoverers" discover in 1900? A New Analysis of the Birth of Genetics
Yafeng Shan
Science and Technology Studies, University College London, London, UNITED KINGDOM

What do Wound Repair, Chimeras, and Embryonic Stem Cells Have in Common?
Jane Maienschein
School of Life Sciences, Arizona State University, Tempe, AZ, and Marine Biological Laboratory, Woods Hole, MA, USA

Karl Pearson's phenomenalism : Its impact on the theories of heredity and evolution in the early 1900s
Jean Gayon
Université Paris 1 Panthéon-Sorbonne, FRANCE

Venue - Main Building, Room 14

1:30PM-3:30PM

A2.16 Philosophical Logic
Contributed Papers

Chair
Frederik Van De Putte, Ghent University

On Search for Law-Like Statements as Abductive Hypotheses by Socratic Transformations
Mariusz Urbanski
Department of Logic and Cognitive Science, Adam Mickiewicz University, Poznan, POLAND
Andrzej Wisniewski
Department of Logic and Cognitive Science, Adam Mickiewicz University, Poznan, POLAND

An adaptive logic for the abduction of minimal explanations
Frederik Van De Putte
Philosophy and Moral Science, Ghent University, Gent, BELGIUM

An Adaptive Approach to Frege's Set Theory
Diderik Batens
Philosophy, Ghent University, Gent, BELGIUM

Venue - Main Building, Room 8

1:30PM-3:30PM

A2.23 Philosophical Logic
Contributed Papers

Chair
Leila Haaparanta, University of Tampere

Dualism about Unrestricted Generality
Martin Pleitz
Department of Philosophy, Muenster University, Muenster, GERMANY

On Virtuous Inferring
Leila Haaparanta
Philosophy, University of Tampere, Tampere, FINLAND

Transconsistency: Consistent Identity of Proofs in Inconsistent Logic
Yoshihiro Maruyama
Department of Computer Science, University of Oxford, Oxford, UNITED KINGDOM

Venue - Main Building, Room 7

1:30PM-3:30PM

A2.24 Philosophical Logic
Contributed Papers

Chair
Risto Vilkko, University of Helsinki

Fregean Function Levels in Formal Languages
Yaroslav Kokhan, Department of Logic and Methodology of Science, Institute of Philosophy, National Academy of Scien, Kyiv, UKRAINE

Venue - Main Building, Room 17

1:30PM-3:30PM

B1.9 Methodology
Contributed Papers

Chair
Aki Lehtinen, University of Helsinki

A Little Less Representation, A Little More Action Possibilities: Taking the Artefactual View of Scientific Models Seriously
Guilherme Sanches de Oliveira
Philosophy, University of Cincinnati, Cincinnati, USA

Agenda of analysis of models: from Big Data to reality
Zhan Zagidullin
Department of the Theory of Knowledge, Russian Academy of Science,Institute of Philosophy, Moscow, RUSSIAN FEDERATION

Allocating confirmation with robustness
Aki Lehtinen
Dept. of Political and Economic Studies, University of Helsinki, University of Helsinki, FINLAND

Venue - Main Building, Room 6

1:30PM-3:30PM

B2.8 Formal Philosophy of Science and Formal Epistemology

Contributed Papers

Chair
Roberta Ferrario, Italian National Research Council

Reassessing lacunae problems for scientific theories
Damian Islas, Philosophy, University of Toronto, Toronto, CANADA

The Principle of Observability, the "Stage of Empirical Weightlessness of a Theory", and "Constructive Empiricism"
Andrey Pavlenko
Ontology, Institute of Philosdophy, Moscow, RUSSIAN FEDERATION

Suppes' latest production: probabilistic empiricism and experimental practices beyond formal methods
Roberta Ferrario
Institute of Cognitive Sciences and Technologies, Italian National Research Council, Trento, ITALY
Viola Schiaffonati
Dip. di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milano, ITALY

Venue - Main Building, Auditorium II

1:30PM-3:30PM

B2.9 Formal Philosophy of Science and Formal Epistemology

Contributed Papers

Chair
Paul Bartha, University of British Columbia

The Relatively Infinite Value of Nature
Tyler DesRoches
Department of Philosophy, University of British Columbia, Vancouver, CANADA
Paul Bartha
Department of Philosophy , University of British Columbia, Vancouver, CANADA

Realistic Rationalism and Formal Science
Nikita Golovko
Philosophy, Novosibirsk State University, Novosibirsk, RUSSIAN FEDERATION

Inference based on content relations
Jean-Marie Chevalier
Philosophy, University of Helsinki, Paris, FRANCE

Great Expectations
Daniel Rubio
Philosophy, Rutgers University-New Brunswick, New Brunswick, New Jersey, USA
Eddy Keming Chen
Philosophy, Rutgers University-New Brunswick, New Brunswick, New Jersey, USA (presenting author)

Venue - Main Building, Room 10

1:30PM-3:30PM

B3.9 Metaphysical Issues in the Philosophy of Science

Contributed Papers

Chair
Fabio Sterpetti, Sapienza University of Rome

How to be a Historically Motivated Scientific Anti-Realist
Greg Frost-Arnold
Philosophy, Hobart and William Smith Colleges, Geneva, USA

Realist Historical Challenges
Timothy Lyons
Philosophy, Indiana University-Purdue University Indianapolis, Indianapolis, IN, USA

Science's Success. An Argumentative Analysis
Octavian Repolschi
Philosophy and Communication Sciences, West University of Timişoara, Timişoara, ROMANIA

Stanford's New Induction as an Evolutionary Debunking Argument
Fabio Sterpetti
Philosophy, Sapienza University of Rome, Rome, ITALY

Venue - Main Building, Room 12

1:30PM-3:30PM

B5.1 Historical Aspects in the Philosophy of Science

Contributed Papers

Chair
Soshichi Uchii, Kyoto University

Poincaré on Beauty in Science
Milena Ivanova
Munich Center for Mathematical Philosophy, Ludwig Maximilian University of Munich, Munich, GERMANY

The winding road between true knowledge and moral certainty in Descartes' philosophy of nature
Zuraya Monroy-Nasr
Faculty of Psychology, National Autonomous University of Mexico, MEXICO CITY, MEXICO

Leibniz's Theory of Time
Soshichi Uchii
Philosophy and History of Science, Kyoto University, Ikoma, Nara, JAPAN

Tacit Knowledge and Logical Positivism
Artur Koterski
Dept. of Logic and Cognitive Sciences, Maria Curie-Sklodowska University, POLAND

Venue - Main Building, Room 3

1:30PM-3:30 PM

C2.12 Philosophy of the Physical Sciences

Contributed Papers

Chair
Maria Panagiotatou, University of Athens

Quantum Mechanics and Scientific Realism: restoring a misconceived relation
Maria Panagiotatou
Department of Philosophy and History of Science, University of Athens, Athens, GREECE

(Dis)Solving the Measurement Problem
Ilkka Pättiniemi
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

On the notion of a-spatiotemporal beables in quantum gravity, or: Can we dispense with space and time as fundamental categories?
Antonio Vassallo
Philosophy, University of Lausanne, Lausanne, SWITZERLAND

Chemistry, Paradigms, and a View of Epistemic Pluralism: To the Issue of the Nature of Disagreements in Philosophy and in Science
Rein Vihalemm, Department of Philosophy, University of Tartu, Tartu, ESTONIA

Venue - Main Building, Room 13

1:30PM-3:30 PM

C3.5 Philosophy of the Life Sciences

Contributed Papers

Chair
Thomas Reydon, Leibniz Universität Hannover

Lineages and Identity in Systematics: A Critique of de Queiroz's solution to the Species Problem
Celso Antonio Alves Neto
Philosophy, Leibniz Universität Hannover, Hanover, GERMANY

An improved relational semantics of biological modalities
Maximilian Huber
Department of Philosophy, University of Geneva, Geneva, SWITZERLAND

Darwin's solution to the species problem revisited: Can instrumentalism about species in taxonomy and realism about species in evolution be combined?
Thomas Reydon
Institute of Philosophy, Leibniz Universität Hannover, Hannover, GERMANY

The 'Darwinian revolution' and the implications of different essentialism-related reasoning patterns
Edit Talpsepp
Philosophy, University of Tartu, Tartu, ESTONIA

Venue - Main Building, Room 15

1:30PM-3:30 PM

C4.4 Philosophy of the Cognitive and Behavioural Sciences
Contributed Papers

Chair
Mila Marinova, New Bulgarian University

Intertheoretic conflict as a mark of science – and why the neuroscience of consciousness is then no science
Sascha Benjamin Fink
Institute of Philosophy, University of Magdeburg, Magdeburg, GERMANY

Cognitive phenomenology and the subtraction methodology
Juraj Hvorecky
Department of analytic philosophy, Institute of Philosophy, Czech Academy of Sciences, Prague, CZECH REPUBLIC

Synesthetic Experiences and the Philosophical Puzzles of Qualia
Mila Marinova
Cognitive Science and Psychology, New Bulgarian University, Varna, BULGARIA

The Neural Correlates of Conscious Content from a Mechanistic Standpoint
Alfredo Vernazzani
Institut für Philosophie, Universität Bonn, Bonn, GERMANY

Venue - Main Building, Room 16

1:30 PM-3:30 PM

Recent Progress in Formal Theories of Truth
Symposia

The Innocence of Truth
Cezary Cieśliński, University of Warsaw

Models of Weak Theories of Truth
Mateusz Łełyk, University of Warsaw

Compositional Truth Predicate with Δ0 Induction
Bartosz Wcisło, University of Warsaw

Formalizing Yablo's Paradox
Michał Tomasz Godziszewski, University of Warsaw

Venue - Main Building, Auditorium IV

3:30 PM-4:00 PM

Coffee

Venue - Main Building, new side

4:00 PM-6:00 PM

Plenary Lecture: Patricia Blanchette
Plenary Lectures

Chair
Benedikt Löwe, Universiteit van Amsterdan & Universität Hamburg

Models in Geometry and Logic: 1880-1920
Patricia Blanchette
University of Notre Dame, Indiana, USA

Venue - Main Building Great Hall

PLENARY LECTURES

Logic in Play

van Benthem Johan
Amsterdam, Stanford, and Beijing
Monday, August 3 • 17:00 - 18:30
Main Building Great Hall

Logic has had two aspects throughout its history. It is a theory of what follows from what when describing the structure of reality -- but also, it offers an account of rational intellectual activity as shown in making decisions or engaging in debate. On the first view, logic would even govern a lifeless storm-swept universe; on the second view, the nature of the reasoning agents is crucial as well as their activities. Of course, the two views, one more static, the other more dynamic, are not at odds: agents have come to be successful in harmony with the world they live in.

In this lecture, I explore the agency perspective through the lense of interfaces between logic and games. Games are a microcosm of about every major notion that has been studied separately in philosophical and computational logic, and their uses extend well beyond, into epistemology and the methodology of science. I will first consider current uses of logic to understand games, or more generally, the laws that underlie information-driven intentional behavior of agents that pursue goals, and that do so by interacting strategically. This leads to what may be called a 'theory of play' merging ideas from logic and game theory. But then I reverse perspective, and consider uses of games to elucidate basic notions in logic, including dialogical accounts of the very logical constants. In my view, this circle, or helix, is the DNA of the field. But the connection between the two perspectives is not unproblematic or well-understood, and I will also point at some serious issues in understanding the total picture.

In the final part of my lecture, I will look at some more general methodological issues confronting the study of logic and rational agency, illustrated by themes from the games arena that we saw earlier. These issues are not particular to logic, and can also be discerned in other fields represented at this Congress. I intend to discuss the methodological shift from being to change as a major focus of study, as well as two challenges emanating from contacts with other disciplines where agency is crucial. One is the challenge of evolutionary game theory or dynamical systems with successful low-rationality scenarios, and the other is the modern encounter with empirical cognitive science, where the received descriptive/normative boundary protecting the inner sanctum of traditional logic sometimes seems at breaking point when streams of intellectual traffic clamor for permission to cross.

References: J. van Benthem, 2011, "Logical Dynamics of Information and Interaction", Cambridge University Press; 2014, "Logic in Games", The MIT Press, 2015, 'Fanning the Flames of Reason', ILLC, University of Amsterdam.

Repertoires: How to Transform a Project into a Research Community

Ankeny Rachel A.
University of Adelaide, AUSTRALIA
Leonelli Sabina
University of Exeter, UNITED KINGDOM
Tuesday, August 4 • 09:00–10:30
Main Building, Room 1

How effectively communities of scientists come together and co-operate is crucial both to the quality of research outputs and to the extent to which such outputs integrate insights, data and methods from a variety of fields, laboratories, and locations around the globe. This essay focuses on the ensemble of conditions that make it possible for a short-term collaboration, set up to accomplish a specific task, to give rise to relatively stable communities of researchers. We refer to these distinctive features as repertoires, and investigate their development and implementation across three examples of collaborative research in the life sciences. We conclude that whether a particular project ends up fostering the emergence of a resilient research community is partly determined by the degree of attention and care devoted by researchers to a variety of material and social elements connected in part to their underlying epistemological commitments beyond the specific research questions under consideration.

Scientific Realism, Models and the Social and Behavioral Sciences

Harold Kincaid
University of Cape Town, SOUTH AFRICA
Wednesday, August 5 • 09:00–10:30
Main Building Great Hall

Debates over realism at the level of entire theories or sciences probably rest on overoptimistic philosophical pretensions. More local debates over specific pieces of science that are strongly connected to the scientific evidence itself I argue can be fruitfully approached by philosophers of science. I look at two categories of realism questions in the social and behavioral science: debates over the reality of social and behavior categories and debates over unrealistic models. In the first category I look at debates over the reality of psychopathological classifications and social class. In the second category I argue that completely general attempts to solve the puzzle of unrealistic models over reach but that there are many interesting questions when the issues is translated into one about causal models.

Cubical homotopy type theory and univalence

Awodey Steve
Carnegie Mellon University, Pittsburgh, UNITED STATES
Thursday, August 6 • 09:00–10:30
Porthania I

In this work-in-progress talk, I will present the cubical model of homotopy type theory recently developed by Coquand et al., making a few modifications along the way. The basic category of cubes is simplified by exploiting the duality between cartesian cubes and bipointed sets. The presheaf category of cubical sets is then a classifying topos with good logical, combinatorial, and geometric properties. The Kan extension property familiar from algebraic topology is just what is required to model the identity-type rules of Martin-Löf. The univalence axom of Voevodsky is then considered in the cubical setting, which is more constructive than the classical one of simplicial sets.

Spacetime Functionalism

Knox Eleanor
King's College, London, UNITED KINGDOM
Friday, August 7 • 09:00–10:30
Main Building Great Hall

Many (perhaps all) concepts in science are functional, but the idea that we should conceive of spacetime as whatever fills some functional role has not been much explored. Nonetheless, a functional conception of spacetime seems to be required by some theories of quantum gravity in which spacetime is non-fundamental. I'll argue that functionalism is also helpful in the context of classical spacetime theories; it has the potential to dissolve some old problems. I'll look at possible consequences of spacetime functionalism for the debate between the substantivalist and the relationist, and for various debates over the 'right' space in which to set a given theory.

Models in Geometry and Logic: 1880-1920

Blanchette Patricia
University of Notre Dame, Indiana, USA
Saturday, August 8 • 16:00–18:00
Main Building Great Hall

In 1909, Bertrand Russell says: I do not prove the independence of primitive propositions in logic by the recognized methods; this is impossible as regards principles of inference, because you can't tell what follows from supposing them false: if they are true, they must be used in deducing consequences from the hypothesis that they are false, and altogether they are too fundamental to be treated by the recognized methods.[1]

Similar remarks appear in Russell's *Principles of Mathematics*, in *Principia Mathematica*, and in the 1906 "The Theory of Implication." The sentiment expressed in these passages is a strange one, especially given its setting in the first decade of the twentieth century. The modern method of demonstrating independence had become, by this point, standard fare, having been applied already in geometry, arithmetic, analysis, and class theory. And despite Russell's concerns, the method was soon to be applied (by Bernays) to demonstrate the independence of Russell's own fundamental principles of logic as expressed in *Principia Mathematica.*

Russell, in short, would seem simply to be wrong to claim that the "recognized methods" for proving independence are inapplicable to principles of logic, and wrong to suppose that those methods require us to make sense of the supposition of falsehood on the part of the truths to be proven independent. But there is, I hope to show in this lecture, more to it than this. Russell's understanding of independence proofs, and more generally of the role of models in the very early years of the twentieth century, is due in large part to his position in the middle of a rapidly-changing way of understanding models and their roles in independence and consistency proofs. The change from primarily geometric models in the late 19th century to models of more algebraically-conceived theories in the early 20th century brought with it (not always entirely clearly) a shift in the line of reasoning that proceeds from model-construction to independence- claim. It also brought with it important changes in the ways that we conceive of independence itself, and hence of consistency. My hope is that greater clarity about the conceptual shifts taking place in this period will shed light both on our contemporary understanding of various aspects of independence and consistency, and on intriguing aspects of the notions that were left behind in this period.

[1] Russell to Jourdain, April 1909; see Grattan-Guinness (ed), Dear Russell – Dear Jourdain, Columbia University Press 1977 p. 117.

INVITED SESSIONS

A1. MATHEMATICAL LOGIC

Wednesday, August 5 • 14:30–16:30, 17:00–18:00
Main Building, Small Hall

Constructing normal numbers

Becher Verónica
University of Buenos Aires, ARGENTINA CONICET, ARGENTINA

Flip a coin a large number of times and roughly half of the flips will come up heads and half will come up tails. Normality makes similar assertions about the digits in the expansions of a real number. For b an integer greater than or equal to 2, a real number x is simply normal to base b if every digit d in {0, 1, . . . , b-1} occurs in the base b expansion of x with asymptotic frequency 1/b (in the above example with coin tosses consider b equal to 2); a real number x is normal to base b if it is simply normal to all powers of b; and a real number x is absolutely normal if it is simply normal to all integer bases greater than or equal to 2.

More than one hundred years ago E. Borel showed that almost all (for Lebesgue measure) real numbers are absolutely normal, and he asked for one example. He would have liked some fundamental mathematical constant such as pi or e, but this remains as the most famous open problem on normality. As for other examples, there have been several constructions of normal numbers since Borel's time, with varying levels of effectivity (computability). I will summarize the latest results, including our constructions of numbers normal to selected bases, a fast algorithm to compute an absolutely normal number which runs in nearly quadratic time, and an algorithm to compute an absolutely normal Liouville number. This is joint work with Theodore Slaman and Pablo Heiber.

Entanglement and Formalism Freeness: Templates from Logic and Set Theory

Kennedy Juliette
University of Helsinki, FINLAND

In his 1946 Princeton Bicentennial Lecture Gödel suggested the problem of finding a notion of definability for set theory that is "formalism free" in a sense similar to the notion of computable function --- a notion that is very robust with respect to its various associated formalisms. One way to interpret this suggestion is to consider standard notions of definability in set theory, which are usually built over first order logic, and change the underlying logic. In joint work with Menachem Magidor and Jouko Väänänen we show that constructibility is not very sensitive to the underlying logic, and the same goes for hereditary ordinal definability (or HOD). This setup can be re formulated as a template for study-

ing the phenomenon of "formalism freeness." In the talk we also consider other templates, which we suggest are ways to consider the dual notion of formalism freeness, namely the phenomenon of "entanglement."

Global Reflection Principles

Welch P.D.
School of Mathematics, University of Bristol, UNITED KINGDOM

Recently Martin ([6]), in his discussion of Gödel's Conceptual Realism has emphasised that aspect of Gödel's conceptual realism that can be construed as about concepts rather than objects, and has himself advocated such a form where mathematics is based upon such concepts without such concepts being instantiated in any sense. He illustrates with examples of the natural numbers and set theory.

We outline an extension of this view of a conceptual realism, to a preformalised Cantorian realm of absolute infinities. Introducing then the idea of *Reflection* one may formulate principles of reflection of increasing strength that can be thought of as related to the spectrum of inner models and their embeddings. Ultimately, in the limit, one has a *Global Reflection principle* - (*GRP*), which ensures the universe *V* contains proper classes of large cardinals, such as measurable Woodin cardinals, that Woodin uses as the background for various strong absoluteness results, and, as the notion of Woodin cardinal has become central to modern large cardinal and descriptive set theory, such are generally in multifarious use in modern set theory. Previous classes of Reflection Principles, along the lines of Levy-Montague ([4],[7], [8]), Bernays, ([1] & [2]), and Tait ([10]) only produce large cardinals consistent with $V = L$. Indeed Koellner ([3]) has argued that true *reflection* principles may all be weaker than a large cardinal consistent with *L*.

Previous attempts to adapt reflection to motivate large cardinals have been made by Reinhardt and Marshall ([9] and [5]). However the former takes a view of somehow "projecting the universe" into some "virtual realm" with "ordinals beyond" Ω - the latter the order type of the von Neumann ordinals. The firstorder reformation of this has survived as the notion of an *extendible cardinal*. Marshall similarly obtained extendible cardinals, but she used heavily higher type methods building a 'cumulative hierarchy of classes' beyond *V* and a modified form of reflection. (Some form of modified reflection must be used for higher type reflection as Reinhardt observed: generalised third order reflection will fail.)

Our motivation is to adopt principles that eschew both virtual realms, or formalised higher order methods, whilst retaining a pre-formalised Cantorian view of classes. This is then combined together with a reflection of the whole of *V together with* its absolute infinities, that Burali-Forti, Russell, *etc.* showed must be considered (as Cantor himself knew well).

Set theorists would recognise *GRP* as more motivated by the reflection inherent in a weak version of a subcompact cardinal, rather than Silver-Reinhardt's 'projecting' 1-extendible cardinals. Whilst we think of this reflection as a property of the universe of sets together with classes, in a semi-naive, conceptual setting, prior to formalisation, *GRP* itself can be formalised in *NBG* ([11]) but only specifies reflection in terms of a *first order* language of set theory without class quantifiers, but with free second order variables. Known and elementary set theoretical arguments can then be used to show that *GRP* implies that *V* has a proper class of cardinals that are simultaneously both measurable and Woodin.

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A2. PHILOSOPHICAL LOGIC

Thursday, August 6 • 11:00–13:00
Main Building, Small Hall

Could there be no logic?

Russell Gillian
Department of Philosophy, Washington University St Louis, UNITED STATES

Logical pluralists and monists disagree about how many correct logics there are; the pluralists say there are many, the monists that there is only one. But could it turn out that there is no correct logic? This paper develops the argument for what I'll call logical nihilism by presenting new counterexamples to laws sometimes thought to be quite safe---such as conjunction elimination and identity. Then it argues on general methodological grounds that the best response to this nihilist threat is to relinquish commitment to complete generality in logic.

Logic Revision: Some Formal and Semi-Formal Techniques for Logic Choice

Mares Edwin
Victoria University of Wellington, NEW ZELAND

Building on my recent work on probabilities for very weak non-classical logics, I develop a general semantic framework for rational logic choice. The framework is used to provide a basis for (i) a probabilist theory of logic revision, (ii) a theory of rational debate about logic, and (iii) a theory of negotiation concerning the logic a group or community is to accept. Techniques from formal semantics, simulation theory (from the philosophy of mind), formal pragmatics, and theories of dialogue are employed in developing this theory of logic choice.

A3. COMPUTATIONAL LOGIC AND APPLICATIONS OF LOGIC

Tuesday, August 4 • 11:00–13:00
Main Building, Small Hall

Syntactic Epistemic Logic

Artemov Sergei
The CUNY Graduate Center, New York City, USA

In Memory of John Nash

The traditional representation of an epistemic scenario by a single Kripke or Aumann model, first of all in Game Theory, covers only logically complete cases that specify truth values of all assertions. An appropriate analogy from mathematical logic would be a complete theory defined as a set of true formulas in a given model. It is well-known that this class of theories is too narrow; it does not cover even the first-order arithmetic of addition and multiplication. Likewise, many real life epistemic scenarios are incomplete.

Syntactic Epistemic Logic SEL suggests viewing an epistemic situation as a set of syntactic conditions (formulas) rather than as a model, and thus also representing incomplete descriptions, many of which can be reasonably analyzed. In particular, instead of reasoning about a specific model, in SEL, we deduce properties of interest directly from the syntactic description.

SEL does not suggest revising Epistemic Logic, but rather extending its scope by accommodating incomplete descriptions. However, within the traditional approach, in which a scenario is originally described syntactically and then formalized as a model, a completeness analysis relating these two modes of formalization is required; this was basically never done, which is one of the shortcomings of the semantic approach. As an example, we demonstrate that the Muddy Children scenario MC is syntactically complete and that its popular representation by a Kripke model is adequate. However, we show a natural version of MC which is incomplete and hence not representable by a single model, but still can be analyzed syntactically.

A principal target area of SEL is Game Theory. Conceptually, SEL closes the gap, identified by Robert Aumann (cf. [1]), between the syntactic character of game descriptions and the semantic method of analyzing games.

In his dissertation [2], John Nash based his concept of the solution to a game on the assumption that "the players should be able to deduce and make use of [a rational prediction]." SEL formalizes this Nash's deductive assumptions naturally through a syntactic definition of a strategic game and the notion of Nash definitive solution. As a case study, we investigate when Nash definitive solutions exist for strategic games with ordinal payoffs. Our findings show that a unique Nash equilibrium is a necessary but not sufficient condition for Nash definitive solution and, with respect to Aumann rationality, the ultimate criterion for a definitive solution is provided by the iterated deletion of strictly dominated strategies.

In summary, by Syntactic Epistemic Logic, we promote a broader approach to the ways logic and applications specify epistemic scenarios.

References: [1] R.Aumann. Interview. In Vincent F. Hendricks and Olivier Roy, eds., Epistemic Logic: 5 Questions, Automatic Press/VIP, pp. 21-33, 2010. [2] J. Nash. Non-Cooperative Games. Ph.D. Thesis, Princeton University, Princeton, 1950.

A Logical Revolution

Vardi Moshe Y.
Rice University, USA

Mathematical logic was developed in an effort to provide formal foundations for mathematics. In this quest, which ultimately failed, logic begat computer science, yielding both computers and theoretical computer science. But then logic turned out to be a disappointment as foundations for computer science, as almost all decision problems in logic are either unsolvable or intractable. Starting from the mid 1970s, however, there has been a quiet revolution in logic in computer science, and problems that are theoretically undecidable or intractable were shown to be quite feasible in practice. This talk describes the rise, fall, and rise of logic in computer science, describing several modern applications of logic to computing, include databases, hardware design, and software engineering.

A4. HISTORICAL ASPECTS OF LOGIC

Friday, August 7 • 17:00–18:00
Main Building, Room 5

Intensional logic before Leibniz

Thom Paul
The University of Sydney, AUSTRALIA

The paper brings together two bodies of recent work on the history of intensional logic.

Klaus Glashoff's papers on Leibniz's intensional logics analyse intensional categorical propositions as stating relations of inclusion or exclusion between classes of intensions. Leibniz takes for granted that intensions are uniquely resolvable into sets of simple conceptions. It is this assumption that makes possible his representation of intensional propositions by means of pairs of 'characteristic numbers'.

Recent research on medieval Arabic logic by Asadollah Falahi and by the present author focuses on a distinction (introduced by Rāzī d.1210)between extensional (*khāriji*) and intensional (*ḥaqīqī*) readings of categorical propositions. On the intensional reading, the proposition's truth depends solely on relations of inseparability or incompatibility between conceptions. Logicians who followed this approach were not concerned to give a mathematical representation of intensional propositions; their motivation came rather from features of the genus-species relation in Aristotelian ontology.

The paper explores the similarities as well as the differences between the medieval Arabic and the Leibnitiana approaches. Consideration will be given to the following questions: 1. What are the logical relations hold between intensional and extensional propositions sharing the same terms? 2. Does an intensional logic need to postulate essences? 3. Does an intensional logic need to postulate special axioms regarding the structuring of sets of essences?

References: Glashoff 2002. Klaus Glashoff, 'On Leibniz's characteristic numbers', *Studia Leibnitiana* 34 161-184. Glashoff 2010. Klaus Glashoff, 'An intensional Leibniz semantics for Aristotelian logic', *The Review of Symbolic Logic* 3 262-272. Falahi 2013. Asadollah Falahi, *The Logic of Al-Khūnajī* (Teheran: Iranian Institute of Philosophy). Thom 2010. Paul Thom, "Abharī on the logic of conjunctive terms", *Arabic Sciences and Philosophy* 20 (2010) 105-117. Thom 2012. Paul Thom, "Syllogisms about possibility and necessity in Avicenna and Tusi" in Catarina Dutilh Novaes and Ole Hjortland (eds.), *Insolubles and Consequences* (London: College Publications), 239-248.

B1. METHODOLOGY

Friday, August 7 • 11:00–13:00
Main Building, Room 5

From nowhere, from here now, or from there then. A tale of success-to-truth inferences along perspectivalist lines.

Massimi Michela
University of Edinburgh, UNITED KINGDOM

Success-to-truth inferences have been the realist stronghold for long time. Scientific success has been the parameter by which realism has claimed to be able to discern true theories from false ones, via the No Miracles Argument. But the notion of scientific success has not been scrutinized as much as it should, and the exact nature of the success-to-truth inferences has been the target of famous antirealist arguments. In this paper, I tell the tale of success-to-truth inferences three times, by taking *success from nowhere*, *success from here now* and *success from there then* as my respective starting points. I ultimately argue for a suitable version of *success from there then* that can do justice to the historically situated nature of scientific knowledge while also delivering on the promise of realism. The outcome is a new way of thinking about realism: *perspectival realism*.

But how should the perspectivalist notion of success be understood? I argue that it should be understood 'from within', rather than 'from above', namely it should be assessed on the basis of the historical context in which the theory was formulated (including the available rivals and predecessors), rather than from our current vantage point. The challenge then for the perspectival realist consists in spelling out the criteria of success 'from within' and explain how it can still deliver on the promise of truth (without any Whiggish leanings). I offer a positive proposal and consider possible objections.

Fact, Fiction, and Finance: Methodological Aspects of Econophysics

Rickles Dean
University of Sydney, AUSTRALIA

In this talk I discuss some methodological aspects of econophysics (roughly, the application of statistical physics to economics). Econophysics is believed by many of its advocates to have an advantage over more orthodox economist's approaches both on account of its more 'data-first' approach and its more realistic modelling in terms of notions from complex systems theory and the theory of cooperative phenomena: economic phenomena (of various kinds) are understood to be emergent/collective phenomena of a kind found in natural systems. I'll present examples of such models and consider their workings to see to what extent the econophysicists' claims can be upheld. Recent work on modelling and the transference of models between different contexts will be brought to bear on the matter

B2. INVITED SESSION: FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Wednesday, August 5 • 11:00–13:00
Main Building, Small Hall

Bayesian Philosophy of Science

Hartmann Stephan
LMU Munich, GERMANY

Bayesianism is a leading paradigm in the philosophy of science. Meanwhile it is not only applied to questions regarding the confirmation of scientific theories, but also to many other central themes in the philosophy of science such as scientific explanation, intertheoretic relations, scientific realism, and the varieties of scientific reasoning. Another characteristic of contemporary Bayesian philosophy of science is its close relation to Bayesian cognitive science. This talk has the following goals: (i) It will outline and defend the Bayesian framework. (ii) It will survey several new success stories of Bayesian philosophy of science. Here we will especially focus on recent work on the no-alternatives argument and inference to the best explanation. We will see that Bayesianism illuminates important philosophical debates and that it sheds new light on several challenging problems. (iii) It will discuss some recent responses to various open problems of Bayesianism. Besides new responses to the notorious problem of old evidence, we will discuss the implications of the philosophical idealizations Bayesianism makes (such as the assumption of point probabilities). (iv) Finally, this talk will list a number of problems that should be addressed in future work. Here I will especially stress the importance of the increasingly closer relation between formal philosophy of science and experimental approaches to questions from the philosophy of science. Another desideratum is to provide a satisfactory treatment of idealizations in science that will help bridging the gap between Bayesian philosophy of science and more descriptive accounts in the philosophy of science.

The credit economy and the economic rationality of science

Zollman Kevin
Carnegie Mellon University, USA

Scientists are motivated by the credit they are given for their discoveries by their peers. Traditional theories of the scientific method in philosophy do not include this motivation, and at first blush it appears as though these theories would regard it as inappropriate. A number of scholars have suggested, however, that this motivation serves to perpetuate successful science. It has been proposed as a mechanism to encourage more scientific effort and a mechanism to effectively allocate resources between competing research programs. This paper presents an economic model of scientists' choices in which these claims can be formalized and evaluated. Ultimately, the paper comes to mixed conclusions. The motivation for credit may help to increase scientists effort in science, but also may serve to misallocate effort between competing research programs

B3. METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 14:30–16:30
Main Building, Room 5

In What gives Direction to Time?

Loewer Barry
Rutgers University, USA

The world is full of macroscopic phenomena – so called "arrows of time"-that evolve in one temporal direction but not the reverse direction. For examples, an ice cube in warm water melts but an ice cube never spontaneously forms out of warm water and more generally the entropy of the universe (and isolated subsystems) increases but never decreases , there are records of the past but not the future, we have some influence over the future but not the past, causes precede their effects, we experience time as flowing from past to future. This gives rise to a puzzle since the fundamental dynamical laws of classical and quantum mechanics are temporally symmetric in that for any sequence of configurations of particle positions that is compatible with the laws the temporally reverse sequence is also compatible with the laws. It follows that the dynamical laws by themselves do not explain the temporal asymmetries. So what accounts for the arrows of time? One approach is to attribute them to the metaphysical nature of time itself. This is the path taken by presentists, growing block advocates and those who attribute an intrinsic direction to time itself. While these accounts provide vivid *metaphysical* pictures I will argue that they fail to provide explanations of the temporal asymmetries in the behavior of the material contents of space-time. In contrast are accounts that attempt to account for time's arrows in terms of a *scientific* explanation of the second law of thermodynamics. The best account of the second law involves hypothesizing that at one temporal boundary of the universe – the macro state of the universe cosmologists identify as the Big Bang- the entropy is very small and positing a probability distribution over micro states that are compatible with this low entropy macro state. It will then follow that from this macro state it is very likely that the entropy of the universe would increase from the big bang until the equilibrium is attained. I will provide some reasons to believe that this approach can explain the various arrows of time in addition to the second law and discuss some problems that must be overcome if it is to provide a fully adequate account of why "time is a one way street".

On the Prospects of an Effective Metaphysics

McKenzie Kerry
UC San Diego, USA

Two trends can arguably be discerned in contemporary metaphysics of physics, most notably (though not exclusively) in Ladyman and Ross's *Every Thing Must Go.* On the one hand, there is an explicit embrace of non-fundamental physical ontology *qua* 'effective' ontology: that is, of non-fundamental entities conceived of roughly as they are in non-fundamental theories, and thus independently of more fundamental physical descriptions. On the other hand, there is an explicit disavowal of much contemporary analytic metaphysics, largely on the grounds that its models and assumptions are altogether too classical in character. But since among the effective ontology of physics one finds classical ontology, and since presumably it is classical metaphysics that is appropriate to such ontology, it is not obvious, to me at least, that this is a consistent set of views. It would be consistent if those embracing both these views further committed to the idea that metaphysics should concern itself exclusively with the fundamental. But while the idea that metaphysics is, by definition, the investigation of fundamental structure is one increasingly promoted by analytic metaphysicians, it is unclear to me why we should think that this should be the case. For if one trend in philosophy of physics is to reify non-fundamental entities, and given that such entities have properties, identities, and evolve in accordance with laws of nature, is it not natural to think that there should be a corresponding *non-fundamental metaphysics* corresponding to this ontology, at least if we are sympathetic to metaphysics at all?

In this paper, I will consider whether the embrace of effective ontology in physics suggests a corresponding embrace of 'effective metaphysics': that is, of a metaphysics of non-fundamental reality conceived of independently of the metaphysics of more fundamental regimes. While it strikes me as natural to think that should be so, my case will be a negative one. At the core of my argument is the observation that metaphysical theories typically cannot in any meaningful sense be said to 'approximate' one another. But since it is the existence of relations of approximation that underwrites the embrace of effective physical ontology in the first place, there is nothing in the latter that brings in its train an embrace of effective metaphysics. As such, it seems that the only metaphysics we should countenance is indeed one concerned exclusively with the fundamental.

Of course, since contemporary fundamental physics presents huge challenges to anyone attempting to develop a metaphysical interpretation of it, this is in many ways a disappointing and dispiriting conclusion to many metaphysicians of science. But I will close by arguing that these observations also help us gain a better purchase on the distinction between physics and metaphysics, which should at least bring some conceptual clarification to what naturalistic metaphysics is in the first place.

B4. ETHICAL AND POLITICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Tuesday, August 4 • 11:00–13:00
Main Building, Room 1

Rationality at the science-policy interface

Hansson Sven Ove
KTH Royal Institute of Technology, Stockholm, SWEDEN

From an evolutionary point of view, the reason why we separate out facts from other standpoints and apply special principles (theoretical rationality) to them seems to be that such a separate sphere of facts helps us to achieve practical rationality. Separating out the facts seems to have survival value for organisms like us, given the level and character of our cognitive abilities. Science extends this advantage to the collective level by providing us with a common basis of factual beliefs. In most cases our practical purposes are well served if we base our decisions on this common repertoire of what we take to be reliable information.

But the fit is not perfect. When scientific information is used in policy decisions we have to be rational in two ways: we have to satisfy the requirements of both practical and theoretical rationality. This can give rise to two major types of conflicts between theoretical and practical rationality.

The first type of conflict arises when a higher level of evidence is required for acting as if something is true than for accepting it as scientifically valid. In such cases we tend to adjust the requirements for scientific acceptance upwards so that they coincide with the higher level that is called for in the practical decision. Such adjustments are seldom explicitly discussed but they seem to be quite common for instance in medical science.

The second type of problem arises when practical decision-making requires that we act as if some statement is true, even if the evidence is not strong enough for accepting it as scientifically valid. In such cases we typically do not adjust the requirements for scientific acceptance but instead make decisions based on what we take to be probable enough, even if it is not scientifically demonstrated. Such decisions are often guided by ideas such as the precautionary principle or "better safe than sorry".

I propose that this implicit but rather sophisticated, two-branched strategy is indeed a highly suitable way to satisfy both practical and theoretical rationality, and at the same time keep down the conflicts between the two to the minimum.

Biodiversity and Bio-patenting: Constructive Challenges of Scientific Research

Yi Sang-Wook
Department of Philosophy, Hanyang University, Seoul, South Korea

Scientific research, especially the frontier research tends to pose challenges to our ethical intuitions and social norms. The conflict of current research practice and our ethical and social intuition is however not always destructive; it can often help us clarify the hidden assumptions in our familiar way of thinking, and nudge us to put some order in our conventional practice towards ethical and social issues. I shall consider two related issues, biodiversity and bio-patenting to illustrate how this possibility of 'constructive' challenges of scientific research can be realized, and draw some general implications.

Biodiversity is generally regarded as good, and something worthy of pursuing. The recent implementation of CBD (Convention of Biological Diversity) by Kyoto protocols exemplifies its international, institutional backing. Still, it is not very clear what 'kind' of biodiversity we need to pursue, and how to pursue (preserve vs. conserve). Also, we need to clarify what could be the fundamental moral justification for valuing biodiversity in the first place. These questions are instrumental for resolving the sensitive issues regarding access to genetic information and benefit-sharing in Kyoto protocols.

Scientific research is fundamentally based on free sharing of information among peer scientists. This allows scientists critically evaluate others' results and build on them to move forward to the frontier of their research fields. In this sense, free sharing of information is essential for scientific innovation. We are however familiar with the idea that a patent system helps innovation by financially motivating potential innovators. I will argue that patenting sometimes actually hinders innovation in biotechnology, using the recent lawsuit case regarding BRC gene patent, and suggest better ways to nurture innovation in scientific research.

B5. HISTORICAL ASPECTS IN THE PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 11:00–13:00
Main Building, Room 5

On theories

Demopoulos William
The University of Western Ontario London, CANADA

This presentation is drawn from a longer study of the nature of modern physical theories. The discussion of that study is dialectically situated in the logical empiricist tradition of the partial interpretation reconstruction of theories. But it is not restricted to that tradition. I argue that the logical empiricist account of theoretical knowledge exhibits a fundamental misconception about the character of the claims theories express. This is the idea that the application of the notion of truth to theoretical claims is fundamentally different from its application to empirical statements about observable entities. This idea was completely explicit in the case of logical empiricism's conventionalist account of theoretical claims about the geometry of space and time, but it emerges as an unintended consequence of the doctrine of partial interpretation and the account of theories about entities which transcend observation.

Despite the many differences between conventionalism about geometry and the general conception of theories as partially interpreted systems, the misconception about theoretical claims that these two doctrines exhibit has a common source. It stems in each case from an incorrect assessment of the epistemic warrant theoretical claims enjoy: an incorrect assessment of the nature of the justification of existence claims involving unobservables in the case of partial interpretation, and, in the case of geometry, an incorrect assessment of the epistemological basis for proposals regarding the structure of space and time. This assessment is not peculiar to logical empiricism, and it can be shown to undermine proposals which define themselves by their opposition to the logical empiricist conception of theories.

The view I advocate allows that the value of a physical theory is often instrumental and independent of whether the theory is even "approximately" true. However I argue that this concession to instrumentalism is compatible with the idea that a theory's instrumental value can consist in facilitating the discovery of salient truths about reality, even a part of reality that is entirely hidden from observation. The argument to this conclusion rests on an analysis of the methodology of "theory-mediated measurement" and the role this methodology plays in securing fundamental existence claims of the kind we associate with Jean Perrin in the case of molecular reality and J. J. Thomson in connection with the constitution of cathode rays.

At the Roots of Probabilistic Epistemology

Galavotti Maria Carla
Department of Philosophy and Communication, University of Bologna, ITALY

There is a broad consensus among philosophers of science that probability is an essential ingredient of science and human knowledge at large, and that induction is an essential ingredient of the scientific method. Such a probabilistic approach is usually associated with the impact of the work of authors like Richard Jeffrey and Patrick Suppes in the 1960s, soon followed by many others. While from that time on probabilistic epistemology has progressively flourished to the point of becoming predominant, awareness of its origins has been somewhat neglected. This paper argues that in the first decades of the Twentieth century a probabilistic view of knowledge was embraced by a number of authors working on the foundations of probability and statistics from the perspective of different disciplines, irrespective of their interpretation of the notion of probability. The conviction that "the ideal of an absolute truth is an unrealizable phantom" and that it is probability, not truth, that allows scientific knowledge to be reconstructed in tune with scientific practice, as claimed by Hans Reichenbach in his lecture delivered at the "Neuvième congrès international de philosophie" (1937), was shared among others by British philosopher and mathematician Frank Ramsey and geophysicist Harold Jeffreys, Italian statistician Bruno de Finetti, Polish logician Janina Hosiasson, French mathematicians Émile Borel, Paul Lévy and Maurice Fréchet, and German philosophers and scientists Hans Reichenbach and Richard von Mises. The work of these and other authors operating at the four corners of Europe bears witness to the existence of a

European tradition in probabilistic epistemology that in many respects heralds subsequent literature from the 1960s onwards. A distinctive aspect of this tradition lies in the pragmatist flavour imbuing the writings of many of its representatives, suggesting that pragmatist ideas had a much stronger impact on European scientific philosophy than is usually thought.

C1. PHILOSOPHY OF THE FORMAL SCIENCES

Saturday, August 8 • 13:30–14:30
Main Building, Small Hall

Explanation in Mathematics

Colyvan Mark
University of Sydney, AUSTRALIA

Any proof of a mathematical theorem tells us *that* the theorem in question is true, but some proofs go further and tell us *why* the theorem is true. That is, some, but not all, proofs are explanatory. Call this *intra-mathematical explanation*. Recently it has been argued that mathematics can explain beyond mathematics. According to some, mathematics can explain physical facts. Call this *extra-mathematical explanation*. In this paper I will consider both intra- and extra-mathematical explanations and discuss why they are of philosophical interest. Take extra-mathematical explanation first. It has been the focus of recent debates over mathematical realism and employed in the service of so-called *explanatory indispensability arguments* for mathematical realism. Its very existence is controversial and not all parties agree that there is such a thing. Still, the alleged examples of extra-mathematical explanation are something in which both mathematical realists and nominalists are keenly interested. Next consider intra-mathematical explanation. It is less controversial, being well established in mathematical practice, and there are no obvious metaphysical conclusions beckoning. Although intra-mathematical explanation is usually articulated in realist terms ("tells us why the theorem is *true*"), it need not be. Even fictionalists about mathematics can (and should) acknowledge the difference between explanatory proofs and non-explanatory proofs. Perhaps the former tell us why a particular theorem is *true-in-the-story-of-mathematics*. The mathematical realist has no qualms about appeals to truth simpliciter and can even appeal to mathematical objects in their account of intra-mathematical explanation. But clearly there is more to explanation than the mere existence of a certain class of objects. (Just as the existence of thieves does not explain why Vermeer's painting "The Concert" was stolen.) In short, there is good reason to think that an account of intra-mathematical explanation will be largely independent of the realism–anti-realism debate in the philosophy of mathematics. It is thus a good starting point in coming to grips with mathematical explanation. I will conclude with some speculative remarks about two promising accounts for a theory of intra-mathematical explanation.

Three degrees of Imprecise Probability [IP] Theory

Seidenfeld Teddy
Carnegie Mellon University, USA

Representing a rational agents uncertainties using a non-trivial set of probability functions, rather than a single probability function, is at the core of many varieties of IP theory. In this presentation, I develop three degrees of *Imprecision* in IP theory, which represent ever more substantive departures from the canonical Bayesian theory in which a single probability function suffices to represent an agent's credal state. The first and weakest interpretation of *Imprecision* is where intervals of (de Finetti) *fair prices* for random variables are the result of an incomplete elicitation of a canonical Bayesian agent. The second interpretation is where a single, *fair* (2-sided) *price* for buying and/or selling a random variable is replaced by two *one-sided prices* – denoting respectively a separate maximum buying price and a minimum selling price for a variable. The second interpretation, though allowing choices that are not permitted under the first interpretation, nonetheless, is based on a binary comparison between variables. The third interpretation recovers sets of probabilities from coherent choice functions over menus of options. By using choice functions that do not reduce to pairwise comparisons between the options in a menu, the third interpretation provides distinct behavioral content to each IP set of probabilities. This allows, for example, an agent to hold a credal set that makes two ordinary events, E and F, independent where the representing IP set consists entirely of probabilities that satisfy the usual condition for factoring a joint probability into the produce of two marginal probabilities: Prob(EF) = Prob(E)Prob(F).

C2. PHILOSOPHY OF THE PHYSICAL SCIENCES

Friday, August 7 • 17:00–19:00
Main Building, Small Hall

The quantum origin of statistical-mechanical probability

Wallace David
University of Oxford, United Kingdom

The consensus view of the probabilities of statistical mechanics is that they are distinctive to statistical mechanics, so that in particular, quantum statistical mechanics involves two conceptually distinct concepts of probability: one quantum, one statistical-mechanical. By considering both the general structure of quantum statistical mechanics, and some concrete case-studies, I will argue that in fact the quantum-mechanical probabilities subsume the statistical mechanical ones. In quantum statistical mechanics - and, insofar as it is an approximation to an underlying quantum theory, in classical statistical mechanics - the only probabilities needed are quantum-mechanical probabilities.

C3. PHILOSOPHY OF THE LIFE SCIENCES

Tuesday, August 4 • 17:00–19:00
Main Building, Small Hall

The transnational turn in the history of science

Barahona Ana
National Autonomous Univeristy of Mexico UNAM, México, MEXICO

The field of science and technology studies (S&TS) has recently focused on the need to write connected transnational narratives based on a symmetrical treatment of global and local contexts that describe the dynamics of scientific practices. As Subrahmanyam has pointed out, connected histories, as opposed to comparative ones, need to be written to shade light on local resistances and global trends. This transnational approach of S&TS abandons the nation as a unit of analysis in order to understand the development of science history. It also abandons Euro-US- centred narratives in order to explain the role of international networks and the circulation of knowledge, people, artefacts and scientific practices. This new perspective, according to Turchetti, Herrán and Boudia could promote a novel understanding of science as historical phenomenon. The transnational approach has been influenced by the effects of globalisation, multiculturalism and the formation of circuits of practices, organizations, objects, goods, knowledge and people, in which scientific developments go beyond nation-state borders, being the collaborative networks the units of historical analysis. This new focus pays attention to the flows themselves, and moves away from mere international issues. Thus, recent debates regarding global and local contexts have called attention to circulation networks that explore inter-regional exchanges and transnational circuits that allow quicker cross-border transmission of scientific practices and a faster flow of people, ideas and artefacts.

In the case of historical studies of science in Latin America, a lot of research performed under this approach has indicated that despite their historiographical and epistemological importance, narratives on the national sciences perspective have revealed its analytical limitations. This research has expressed the need to reconstruct transnational stories that account for how the knowledge produced in developing countries forms part of international knowledge as it circulates in international networks of collaboration. This perspective has enabled the production of narratives that go beyond the national framework through analysis of transnational participants and processes, and has permitted new ways of thinking about science history in national and regional contexts. Some of these historians have insisted on more transnational and global histories that take into account the dynamics of scientific practices.

Information and Causation in Biology

Griffiths Paul E.
University of Sydney, Sydney, AUSTRALIA

Francis Crick proposed that biological specificity exists in the combinatorial structure of nucleic acids, as well as in the complex, three-dimensional structures of biomolecules (Crick, 1958). This has been described as the birth of a new, informational conception of biological specificity. Biological specificity can be analysed as a form of 'causal specificity', a prominent idea from recent work in the philosophy of causation. A conception of information as a particular kind of causal structure, derived from Crick's own use of the term 'information' can do much of the work that philosophers have sought to do by defining richer, and often highly problematic, sense of biological information (Griffiths & Stotz, 2014).

I begin by describing work by myself and several collaborators on information theoretic measures of causal influence, namely causal specificity (Griffiths et al., In Press) and information flow (Ay & Polani, 2008). These measures can be used to provide quantitative measure of biological specificity and to vindicate the idea that not only coding sequences in the genome but non-coding regulatory sequences and epigenetic and exogenetic regulatory factors are sources of specificity ('distributed specificity' Griffiths and Stotz 2014).

I will then argue that the idea that some but not all causal factors in biology are sources of information for their effects can be adequately understood as a claim about the specificity of those causes, and that other features that have been identified in the philosophical literature as necessary features of biological information are neither necessary nor desirable. Our claim about 'distributed specificity' can be equally well stated as a claim about the sources of biological information.

Finally, drawing on recent work with collaborators, I will show that information theoretic measures of specificity can be integrated with the popular 'signalling' approach (Skyrms, 2010) to construct a minimal sense of semantic content applicable to signals in molecular networks and perhaps more broadly. This conception of semantic content analyses it too as simply a particular kind of causal structure.

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C4. INVITED SESSION: PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Friday, August 7 • 11:00–13:00
Main Building, Small Hall

The Rewards of Associative Modeling

Buckner Cameron
University of Houston, USA

The standard methodology of comparative psychology presumes that associative processes are mutually exclusive with cognitive processes, and, since associative models are more parsimonious, they are to be preferred to cognitive models by default. In my previous work, I have challenged these assumptions: because cognitive models can sometimes be more parsimonious than associative models and a sufficiently flexible associative process can implement a cognitive process, this methodology cannot be regarded as generally coherent. However, we should not conclude from this outcome that associative modeling has no role to play in a healthy comparative psychology, or that associative models can at best offer second-rate "implementation stories" for cognitive models. Associative models are legitimate psychological models in their own right, and should rather be viewed as peers with cognitive models--sometimes competing with them, but other times complementing them when combined in the right ways.

In this talk, I will emphasize the interrelated benefits that can be derived by combining associative modeling with cognitive modeling of the same psychological process. First, associative models can be much more constrained by learning data than cognitive models, granting increased confidence in the model and a finer degree of control over the trajectory of learning itself. Second, associative models often allow one to integrate a result with a wider range of other findings by making fewer domain-specific assumptions. Third, an associative model's learnable structure-types need not be limited to a fixed set of representational primitives, allowing a wider exploration of the hypothesis space. Fourth, pairing a cognitive model with a corresponding associative model can make the former more biologically plausible, especially when focusing only on behavioral strategies that could be acquired with biologically plausible learning data. Fifth, associative models can help ground cross-species and evolutionary comparisons, given the phyletic ubiquity of associative learning. Finally, and perhaps most importantly to recent advances in cognitive science, associative models can justify and ground the representational primitives of a cognitive model. Perhaps unsurprisingly, these benefits are especially strong when the associative model is neuroanatomically inspired, which is to be expected given recent advances in mechanistic approaches to explanation.

I conclude by sketching a revised standard methodology for comparative psychology that integrates cognitive and associative modeling, highlighting the variety of ways that models can relate to one another and the underlying phenomena they purport to explain.

What is action-oriented perception?

Drayson Zoe
University of Stirling, UNITED KINGDOM

In the cognitive sciences, it is increasingly common to find the claim that perception is action-oriented in some sense: perceptual states, processes, and capacities are often described as "active", "for action", or "an achievement by an agent". My concern is that this loose talk of the relation between perception and action conceals important distinctions and disagreements between the philosophers, psychologists and neuroscientists who adopt this terminology. In the first part of the this paper, I delineate the different ways in which perception can be described as action-oriented: as a natural kind, as a mechanism, as a vehicle of content, as perceptual content, or as the phenomenal character of perceptual content. I argue that each of these approaches involves distinct commitments, such that none is directly entailed by any of the others.

In particular, I focus on the difference between thinking about (a) the vehicles of perception, and (b) the contents of perception, as action-oriented.

To say that the vehicles of perception are action-oriented is to claim that there is a semantically-interpretable system in which sensory process and motor processes are coupled or encapsulated, such that a representational state yields motor output from sensory input without involving further processing. Examples of such action-oriented vehicles of perception include dorsal computational states in the dual visual system, and Jacob and Jeannerod's visuomotor representations. Notice that a commitment to action-oriented vehicles can be neutral with respect to the content of the representations. To be representations, the notion of content must be doing some explanatory work, but it can be left open whether this content is determined by the functional role of the vehicle within the system or by its causal connections to the external world, for example.

To say that the contents of perception are action-oriented is to claim that the properties detected by perception are action-related: affordances of some sort. This is the claim that perceptual content is rich enough to include properties like the edibility of an apple or the climbability of a tree, and thus that such properties can be perceived rather than merely believed as the result of inference from sparser perceptual properties (see Siegel, Nanay, Millikan for representative claims). Notice that a commitment to action-oriented perceptual contents can be neutral with respect to bearers of content. No commitment to discrete vehicles of content is required: there need be no internal representations, as with Gibsonian approaches.

In the latter part of the paper, I apply these considerations to Clark and Wheeler's notion of 'action-oriented representation' which has played a significant role in embodied approaches to cognitive science. I show that both Clark and Wheeler expect their accounts to do double duty as a claim about the action-oriented nature of both vehicles and contents, while providing neither a theory of vehicle individuation nor a theory of content determination. I use this case-study to show why we need a clearer notion of 'action-oriented perception' in cognitive science.

C5. PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Saturday, August 8 • 13:30–14:30
Main Building, Room 5

Scaffolding and Bootstrapping: How Archaeological Evidence Bites Back

Wylie Alison
Departments of Philosophy and Anthropology, University of Washington, UNITED STATES
Department of Philosophy, Durham University, UNITED KINGDOM

A passion for things has taken hold in the social sciences and humanities in the form of an enthusiasm for the capacity of material evidence to bear witness to dimensions of social, cultural life that are largely inaccessible to conventional archival and 'reactive' methodologies (face-to- face, experimental, and survey research). As Daston puts it in *Things that Talk* (2008: 15), the "bony materiality" of physical traces of human action sustains a certain epistemic optimism; they can be a uniquely candid source of insight about what actually happened. But at the same time, Daston reports considerable ambivalence about their status as evidence; they are notoriously enigmatic, "speaking" only when we animate them through interpretation or projection. Methodological questions about how material traces can be effectively used as evidence figure prominently in these contexts. As Werrett puts it, historians of science have a "relatively limited disciplinary repertoire" for working with the material culture of science; they tend to proceed by "reading about things rather than engaging with them directly" (2015: 346).

It is primarily archaeologists who have taken up these challenges and built a repertoire of research strategies specifically designed to mobilize the evidence of social, cultural lives that survives in material things. To make sense of how physical traces and material culture can constrain interpretation despite being thoroughly a construct, I consider three strategies by which archaeologists elicit new evidence from old data. Two involve quite literal extraction of new data from old: secondary retrieval and practices of recontextualizing material evidence in ways that generate novel insights, sometimes displacing focal questions and challenging fundamental assumptions about the subject of inquiry. The third is a matter of experimental modeling that moves decisively beyond what Currie refers to as "gap compensation" strategies (2014: 194). In analyzing these cases I renew and extend an argument for recognizing that the action in the historical sciences is typically off-stage. Although game-changing discoveries of new trace evidence makes for headline news, it is the painstaking, uncertain practice of building the scaffolding necessary to identify and interpret material traces as evidence that's responsible for major break-throughs in these fields.

References: Currie, A. (2014), *Rock, Bone and Ruin: An Optimist's Guide to the Historical Sciences.* (Ph.D.), Australian National University. Daston, L. (ed.) (2008) *Things That Talk: Object Lessons From Art and Science,* New York: Zone Books. Werrett, S. (2015) Matter and facts: Material culture and the history of science. *Material Evidence: Learning from Archaeological Practice,* ed. R. Chapman and A. Wylie, Routledge, pp. 339- 352.

C6. PHILOSOPHY OF THE APPLIED SCIENCES AND TECHNOLOGY

Thursday, August 6 • 11:00–12:00
Main Building, Room 5

How to bring philosophy back into science – *Epistemological constructivism* as a viable picture of science?

Boon Mieke
University of Twente, Enschede, THE NETHERLANDS

General philosophy of science is concerned with "what is science." This question seems to be relevant for scientists, but the philosophy of science has almost disappeared from science education programs and hardly plays a role in current scientific research practices. At the same time, many philosophers of science believe that their *raison d'être* is not just academic.

In the first part of my paper, I will present some examples of epistemological issues in current scientific research practices to which the philosophy of science may contribute. Then, I will argue that the typical problems philosophers of science are concerned with, build on a 'picture of science' – i.e. philosophical views on 'what is science' – that may not always be productive for making these contributions. Hence, in order to become relevant for science, philosophers of science may need to reflect on their own presuppositions about science, so to speak. Furthermore, the philosophy of science should work towards a picture of science that meets criteria of productiveness for scientific practices. Scientific realism, anti-realism and social constructivism are often taken as candidate, yet competing philosophical views on 'what is science', whereas pragmatic approaches aim to get around these unsolvable debates. However, scientific realism and so forth, reflect in fact (incoherent) pictures of science that many scientists maintain when they think or talk *about* science; which at a more fundamental level hinders their ability to analyze and solve intricate epistemological issues. Therefore, instead of either taking this as a proof for the appropriateness of these views, or just ignoring them as pragmatist approaches tend to do, philosophers of science should critically reflect on their productiveness and propose viable alternatives.

In the second part, I will propose *epistemological constructivism* as a possible alternative. The core of this alternative is a 'non-representational' account of scientific knowledge, which, instead of building on the notion of representation, explicates scientific knowledge in terms of (1) the irreducible material and technological side of the experimental sciences, (2) constructive epistemic activities such as scientific concept formation and modelling intricately related to the former, (3) regulative (rather than metaphysical) principles that direct these epistemic activities, and (4) a number of epistemic criteria that guide in the acceptance of knowledge. My conjecture is that this alternative suits better in explaining the successfulness of science, in particular when considering the contribution of science to technology and its abilities of problem-solving.

Literature: Boon, M. (2012) *Scientific Concepts in the Engineering Sciences: Epistemic Tools for Creating and Intervening with Phenomena.* In: Scientific concepts and investigative practice. Berlin studies in knowledge research (3). De Gruyter, Berlin, 219 - 243. ISBN 9783110253610. Boon M. (forthcoming). "Contingency and Inevitability in Science – Instruments, Interfaces and the Independent World." Chapter 6 In: L. Soler, E. Trizio and A. Pickering (eds.). *Science as It Could Have Been: Discussing the Contingent/Inevitable Aspects of Scientific Practices*. Pittsburgh: University of Pittsburgh Press. Chang, H. (2009). "Ontological Principles and the Intelligibility of Epistemic Activities." In: *Scientific Understanding: Philosophical Perspectives*. Henk W. de Regt, Sabina Leonelli, and Kai Eigner (eds.) Pittsburgh: Pittsburgh University Press. 64-82. Giere, R. (2006). *Scientific Perspectivism*. Chicago & London: University of Chicago Press. Grüne-Yanoff, T. (2014). "Teaching philosophy of science to scientists: why, what and how." European Journal for Philosophy of Science 4(1): 115-134. Hacking, I. (1992). "The self-vindication of the laboratory sciences". In: *Science as practice and culture*. A. Pickering (Ed.), Chicago: University of Chicago Press. 29–64. Knuuttila, T. and Boon, M. (2011) *How do Models give us Knowledge? The Case of Carnot's Ideal Heat Engine. European Journal for Philosophy of Science*, 1(3): 309-334. ISSN 1879-4912. DOI 10.1007/s13194-011-0029-3.

C7. PHILOSOPHY OF MEDICINE

Thursday, August 6 • 12:00–13:00
Main Building, Room 5

Molecular medicine: the clinical method enters the lab
What primary tumor culture teaches us

Boniolo Giovanni
Univ. of Milano & IEO, Milano, ITALY

Over the last five-six decades an enormous leap forward in biomedical knowledge has been done, thanks to both the discoveries in the field of molecular biology and the amazing biotechnological innovations. On the other hand, it is almost a shared platitude to assert that we are facing a new era in medicine. Nevertheless it seems not so shared the idea that we need to pause and reflect on what is happening in order to grasp whether we are spectators of a really new manner of practicing medicine, that is, whether molecular medicine truly involves novelties. It could be said that "Molecular Medicine strives to understand normal body functioning and disease pathogenesis at the molecular level, which may allow researchers and physician-scientists to use that knowledge in the design of specific molecular tools for disease diagnosis, treatment, prognosis, and prevention (http://molmed.org/home)". This is certainly true, but it does not help us in understanding whether it implies an innovative way of considering and practicing medicine.

Differently I propose that the novelty in molecular medicine consists in its method, which, as I will show, can be considered as a fusion between that one adopted at the patient's bedside and that one adopted in a molecular lab. I will justify this claim by discussing the differences between usual cancer cell lines and primary tumor cultures

C8. METAPHILOSOPHY

Saturday, August 8 • 14:30–15:30
Main Building, Room 5

Intuition and Replication

Nagel Jennifer
University of Toronto, Toronto, CANADA

Why do philosophers mark some of their claims as intuitive? According to critics of the idea that philosophy relies on intuitions as evidence, "intuitive" and its cognates are relatively meaningless labels that can be applied to any judgment at all, or markers we use to switch the focus away from first-order subject matter and onto the author's psychology. However, textual analysis of a broad spectrum of recent philosophical works shows that words like "intuitively" function as discourse markers: to mark a claim as intuitive is not to shift the focus onto one's own private psychological history but to invite the reader to attempt a replication of the author's way of judging that claim. Where our intuitions are not shared, we have a problem of failure of replication. Looking at the recent data on epistemic intuitions, I defend intuition-driven epistemology against the charge that its replication failure rate is especially problematic.

INVITED SESSIONS

SPECIAL SESSIONS

SPECIAL SESSION ON CLMPS 2015 CONFERENCE THEME: MODELS AND MODELLING

Monday, August 3 • 12:00–13:00 (Weisberg)
Friday, August 7 • 14:30–16:30 (Cresto, Mäki)
Main Building, Room 1

Confirmation Theory for Idealized Models

Weisberg Michael
University of Pennsylvania, USA

When a flu pandemic strikes, who should get vaccinated first? What's our best strategy for minimizing the damage of global climate change? Why is Philadelphia racially segregated? Why do most sexually reproducing species have only two sexes, in roughly even proportions? These and many other scientific and practical problems are studied with highly idealized mathematical and computational models. When should we believe these models and follow the advice they suggest? Philosophy of science tells us that we should believe models when they are well-confirmed, but this simple answer isn't very helpful here. Traditional confirmation theory explains how empirical evidence bears on the *truth* of hypotheses and theories, but the highly idealized models at the heart of the life and social sciences are known to be false from the outset. Moreover, classical ideas about confirmation have been developed for relatively simple hypotheses, while many contemporary models have thousands of variables.

Despite these challenges, it is possible to develop an account of model confirmation that can speak to the reliability of models and their results. I will sketch a theory that has two parts: First, theorists *validate* models, confirminghypotheses about model/target system relations. Second, they employ *robustness analysis* to investigate the stability of model results. Taken together, validation and robustness tell us when models are reliable and help us understand the appropriate domain of their application. Not only does this theory better align our accounts of scientific method with modern theoretical practice, it also helps us understand when to believe the results of models.

Models and Modelling in Formal Epistemology: Some Thoughts on Probability Aggregation

Cresto Eleonora
University of Buenos Aires, ARGENTINA The National Scientific and Technical Research Council, ARGENTINA

In this talk I give an account of probability aggregation that improves upon previous attempts to deal with the topic, and I show how the account I favor exhibits some desirable features of model-building in formal epistemology. I start by discussing, in quite general terms, the role of models and modelling in formal epistemology. In the most interesting cases, I take it, such models enable us to provide an explanation for a particular phenomenon, and they can even have (some) predictive power for actual agents. I then illustrate this general claim with a proposal for probability aggregation. Rather than just stipulate an aggregation method, I develop a strategy that helps us understand the underlying mechanism behind several aggregation procedures, in a principled way.

In a nutshell, I suggest that, under certain circumstances, it is convenient to look at probability aggregation as a type of cooperative bargaining. Individual agents can be interpreted as holding utilities over possible probability assignments to propositions, such that, for a given proposition p, each agent gives maximum utility to the probability of p that each one takes to be 'correct' (i.e., to his or her actual credence on p); utility functions are assumed to decrease continuously from there. Given such utilities, I show how to build an appropriate (pseudo)bargaining situation (for proposition p), such that points inside the bargaining set are correlated with sets of probability assignments by the individual agents. Solving the bargaining problem helps us figure out the probability of p that can be credited to the group as a whole; traditional discussions on the adequacy and correctness of different bargaining solutions become relevant for this context as well. We then obtain a unified perspective on two seemingly disparate phenomena (probability aggregation and cooperative bargaining). Finally, I contend that group probabilities play a crucial role at the time of understanding the acceptance of statements (or full beliefs) by the group *qua* group– and hence that they should figure prominently in any account of group knowledge and judgment aggregation. In this spirit, I show how to use our account to obtain a principled, novel way to solve the Discursive Paradox that is sensitive to the nuances of real life examples within the legal context.

Modelling failure

Mäki Uskali
University of Helsinki, FINLAND

A sound account of modelling should contain resources for identifying and analyzing *modelling failure.* The ability of articulate (at least rudiments of) a systematic account of modelling failure can be used as a test of one's account of model and modelling. Here I expose my own account to such a test. Modelling is a multi-stage and multi-faceted process, so there are multiple sources of and multiple opportunities for possible failure – and multiple ideas of what constitutes failure. To map that plurality, we need a rich account of model and modelling. I will use my own account that portrays a model representation as a multi-faceted activity (eg Mäki 2009, 2011, 2013): Agent A uses multi-component object M as a representative of (actual or possible) target R for **purpose** $\boldsymbol{P}$, addressing **audience** $\boldsymbol{E}$, at least potentially prompting genuine **issues of relevant resemblance** between M and R to arise; describing M and drawing inferences about M and R in terms of one or more **model descriptions** $\boldsymbol{D}$; applies **commentary** $\boldsymbol{C}$ to identify and coordinate the other components; and all this takes place within a **context** $\boldsymbol{X}$.

Each of these components can then be investigated as a possible source of modelling failure. As an illustration, I show how many extant critiques of economics lie somewhere in the above structure, and also how some other possible critiques can be envisaged within this framework. More generally, given that modelling is often considered a somewhat playful and strongly multi-purpose activity, an alleged failure may seem relatively easy to excuse. This, in turn, may make the task of developing an account of modelling failure relatively less easy.

INTERNATIONAL COUNCIL FOR SCIENCE (ICSU) SPECIAL SESSION: HEALTH AND WELLBEING IN THE CHANGING URBAN ENVIRONMENT

Well-being and Health: A Perspective from Philosophy of Science

Alexandrova Anna
University of Cambridge, UNITED KINGDOM
Tuesday, August 4 • 14:30–16:30
Main Building, Small Hall

Health and well-being are now firmly entrenched objects of research across social and medical sciences. Indeed they are part of a Kuhnian normal science. The possibility of their measurement is no longer questioned, only the particular measures are. They are no longer thought to be personal and idiosyncratic, and instead generalizations about them are put forward and tested at social, personal and subpersonal levels. Crucially this normalcy was achieved despite the long-standing unresolved philosophical disagreements about the nature of health and well-being. Can health be defined in a purely statistical way or is it a normative category? Is well-being a mere state of mind or requires mind-independent goodness? Looking at the current sciences it is tempting to conclude that these fundamental questions are irrelevant to them and a progress on these questions is not necessary for the success of the scientific enterprise. I argue that this conclusion is partially correct – in a true Kuhnian fashion the practice of the sciences of health and well-being requires "getting over" certain deep philosophical disagreements. But it does not follow that therefore these enterprises can proceed safely without any new work in philosophy.

What sort of philosophy do these sciences need? First, they need an account of value aptness – what sort of value judgments it is legitimate to make and which ones compromise objectivity of these pursuits? Second, they need an account of measurement that accommodates the many diverse practices that take place under the broad umbrella of these sciences, while at the same time retaining potential for criticizing some of the measures currently used. Finally, these sciences need substantive accounts of health and well-being that feed off the fundamental philosophical theories behind these concepts but also provide practical guidance for which conceptualizations of these states should be deployed in which contexts of research. All of these tasks require tools of philosophy of science and moral philosophy that only partially exist and on which I make progress in this talk.

Health and Well Being in the Changing Urban Environment – An interdisciplinary program of the International Council for Science (ICSU)

Jaron Dov
Drexel University, USA
ICSU, FRANCE

More than half of the world's population now lives in cities. This change is accompanied by a shift in the types of disease (from infectious to non-communicable); new environmental, social, and economic factors that have consequences on health; and a new set of challenges for those concerned with promoting human health and well being. During the next half-century, an additional 3 billion people—mostly expected to become city dwellers—will live on the Earth. We now stand at a crossroads where urban policies related to existing and newly constructed cities will have enormous future implications for human health.

Currently, there is limited understanding of how urban population health is shaped by complex systems of external influences, some at the local and some at the global scale. These influences are themselves produced by the interface of human choice and the natural world. Food, nutrition, water, transport, infrastructure, housing, and energy are all linked to health. Integrating causes and consequences is a complex web of human decisions about daily living and social and political changes. Running through all elements of the picture are health inequalities and differential impacts along axes of human diversity such as age, income, and social class. These interactions have always been with us, but they are increasingly urban.

Policy makers, who must make daily decisions that affect urban health and well being, urgently require sound scientific evidence that reflects the complex matrix of issues involved. There is, moreover, increasing recognition of the need to develop an innovative approach to understanding urban health and wellbeing that integrates interactions between various different processes and factors.

Systems analysis offers such an approach. A systems approach is comprehensive, taking into account as many aspects of the problem as possible as well as feedbacks crossing the boundaries of sub-systems and cutting across scales; it acknowledges the nonlinearity of many underlying processes, uncertainty and unexpected events. It provides an interdisciplinary approach, integrating information from different basic and applied sciences with health information. It has predictive capacity and allows policy makers to determine potential cost, as well as proposing methods to plan and examine different scenarios even when evidence-based information may be incomplete and when controlled experiments cannot be performed. A systems approach can reveal important issues regarding population health on which reliable scientific understanding or analysis are lacking and thus make an important contribution to setting the future global health research agenda and to improving health and well being in the urban environment. It can help to rank alternative policy responses in terms of their advantages and disadvantages, providing a platform for discussion and decision-making.

In the presentation I will delineate the background and goals of this ICSU research program and describe the potential contributions of the ICSU unions to this interdisciplinary program.

INTERNATIONAL COUNCIL FOR SCIENCE (ICSU) SPECIAL SESSION: FUTURE EARTH

Thursday, August 6 • 14:30 –16:30 (Colyvan, McBean)
Thursday, August 6 • 17:00–18:00 (Werndl)
Main Building, Small Hall

Biodiversity and Triage

Colyvan Mark
University of Sydney, AUSTRALIA

We are currently in the midst of one of the largest mass extinction events in Earth's history and there is no end in sight. Many species have little or no chance of survival and for many others their fate depends on the development of promising, implementable conservation management strategies. These strategies include, for example, captive breeding programs, habitat protection, habitat recreation, and reversing various forms of land degradation. An important step in the development of such conservation strategies is deciding where to best focus conservation efforts. The situation is not unlike an under-resourced war-zone hospital, facing regular massive influxes of casualties. Sadly, it is not possible to even attempt to save all the species currently classified as threatened. Like the war-zone hospital, triage measures need to be implemented to determine where we should spend our time and resources. Such measures are controversial for a number of reasons, not least of which is that they sometimes recommend doing nothing and simply allowing a particular threatened species to go extinct. Triage involves a variety of models: population models under a variety of interventions, value-of-information models, economic models of the relevant costs and benefits, and operations-research models for determining optimal conservation strategies. Understanding the role and nature of these models is crucial in appreciating both the justification and potential problems with environmental triage. In this paper I will give a qualified defence of triage, outlining its theoretical underpinnings and highlighting its limitations. I will go on to discuss some of the complications arising for conservation biology from climate change. Protecting the environment involves, amongst other things, preserving biodiversity and curbing anthropogenic global warming, yet, unfortunately, these two tasks can pull in different directions: various climate-change mitigation measures can reduce biodiversity. It is thus important that when considering Earth's future, we look at the big picture with both climate change and biodiversity firmly on the radar.

Transformative Research for a Sustainable Future Earth

McBean Gordon
President, International Council for Science Professor, Western University, London, ON, CANADA

The scientific consensus is that we on our planet have entered the Anthropocene—Age of Man, all humans, a new geologic epoch defined by our own massive impact on the planet. In this context, we need to address a broad scope of interconnected issues, such as biogeochemical flows and biodiversity Integrity, land-system and climate change – which are all interconnected. We need to identify and quantify the planetary boundaries or global "tipping" points that provide a "safe" operating space for humanity. These are critically important policy issues for governments. In the present international context, the issues are being dealt with as disaster risk reduction, climate change and Sustainable Development Goals. In 2015, governments are meeting at the 3rd World Conference on Disaster Risk Reduction in Sendai (March 2015), UN Framework Convention on Climate Change in Paris (December, 2015) and in-between at the UN on Sustainable Development Goals (September 2015). How can science best provide the inputs to these policy processes and more importantly to help governments and people address the issues? These questions require outputs leading to outcomes that address complex socio- economic, natural, health, engineering, philosophical and cultural issues and most challenging their intersections.

The Program Future Earth: Research for Global Sustainability has, as its goals: "To provide the knowledge required for societies in the world to face risks posed by global environmental change and to seize opportunities in a transition to global sustainability". The program has adopted a unique approach of both a Science Committee and an Engagement Committee t co-design and co-produce the scientific research program. The Science Committee: represents the full spectrum of scientific fields, as well as scientists from other sectors and the Engagement Committee includes representatives from business, civil society and government. The research theme of transformations to sustainability will be a special challenge in dealing with issues such as transformation processes and global and regional governance, including incentives and international law. The challenge for Future Earth will be to bring together interdisciplinary, transdisciplinary teams of scientists to undertake transformative research providing outputs leading to outcomes that make a difference for global sustainability.

"Climate Models and Calibration and Confirmation: The Need for a More Nuanced Picture of Use-Novelty and Double-Counting"

Werndl Charlotte
London School of Economics, UNITED KINDOM

Climate policy needs to be informed by the results of the best climate models, with respect to the issue at hand. To evaluate climate models, it is essential that the best available methods for confirmation are used. A hotly debated issue on confirmation in climate science (as well as in philosophy) is the requirement of use-novelty (i.e. that data can only confirm models if they have not already been used before, e.g. for calibrating parameters). This paper investigates the issue of use-novelty in the context of the mathematical methods provided by model selection theory. We will first argue that model selection theory provides a good method for evaluating many climate models. Then we will show that the picture model selection theory presents us with about use-novelty is more subtle and nuanced than the commonly endorsed positions by climate scientists and philosophers. More specifically, we will argue that there are two main cases in model selection theory. On the one hand, there are the methods such as cross-validation where the data are required to be use-novel. On the other hand, there are the methods such as the Akaike Information Criterion (AIC) for which the data cannot be use-novel. Still, certain intuitions behind the use-novelty approach are preserved: there is a penalty term in the expression for the degree of confirmation by the data because the data have already been used for calibration. The common positions argued for in climate science and philosophy are either that data should always be use-novel or that the use-novelty criterion is irrelevant. According to modelselection theory these positions are too simple: whether or not data should be use-novel depends on the specific method used. For certain methods data should be use-novel, but for others they cannot be use-novel.

MODELS AND EMPIRICAL PHILOSOPHY: A SESSION IN HONOR OF PATRICK SUPPES

Saturday, August 8 • 10:00–12:00
Main Building, Small Hall

This session pays homage to the memory of Patrick Suppes (March 17, 1922 - November 17, 2014) who made substantial contributions not only to logic and philosophy of science, but to many other fields including physics, psychology, the social sciences, linguistics, probability and statistics. Thanks to his dual militancy as philosopher and applied scientist working in meteorology, learning theory and neuroscience, Suppes forged a novel way of doing philosophy of science that combines sophisticated formalism and careful attention to the details characterizing research within specific disciplines. A pioneer of the semantic view of theories, Suppes embraced a model-centred approach which is a unique blend of empiricism and pragmatism, revolving around the idea that scientific knowledge has an irreducibly tentative and local character, and is to be analysed from a genuinely pluralistic perspective.

Patrick Suppes and the Philosophy of Data Science

Crangle Colleen
Stanford University, USA

Suppes' view of the history of science has been characterized as the ever richer accumulation of empirical data and the development of increasingly powerful methods of computation for making sense of those data. In recent years, data science, and in particular "big data" science, has come to command a larger and larger part of the research budget in many countries. The US National Institutes of Health, for instance, whose annual research budget is over $30 billion, in 2012 announced the Big Data to Knowledge (BD2K) program to support big data research in the biomedical sciences. Suppes, as both philosopher and scientist, was keenly aware of these developments. In this talk, I will consider what might constitute an adequate philosophy of data science, and ask if that philosophy could elucidate a coherent difference between big and small data science. Suppes' work in the last several years of his life on the collection of data from psychotherapy sessions and his approach to the analysis of those data will illustrate. Over the course of several years, audio, video and electroencephalographic (EEG) recordings were made of couples and individuals undergoing therapy for periods ranging from one to 14 months. For many sessions, transcriptions and behavioral coding have been produced, giving unprecedented access to the dynamics of modern psychotherapeutic practice. In analyzing these data to understand the emotions expressed and the interactions between the emotions expressed by a couple in therapy, Suppes eschewed the usual practice of aggregating data over time or over individuals or couples. Rather he chose to conduct a stochastic analysis of the time course of the emotion expressions in each individual. This approach is in many ways the essence of small data science. I will present the first results of Suppes' study of emotion and lay out the plans he had for its further development. I will end with some remarks on Suppes' vision for the collection and analysis of emotion data on a very large scale, showing how that project straddles the divide between big and small data science.

Pat Suppes : from logic to probabilistic metaphysics

Fagot-Largeault Anne
The Collège de France, FRANCE

Patrick Suppes used to minimize his own philosophical import : « It may be thought that what I am advancing … is radical and new, but nothing could be further from the truth … what I have to say here is very much in the spirit of Aristotle » (Paris, CDF conference, 2005). In the same talk, however, taking for granted that « the Kantian program is a dead one », he proposed another program. Three aspects of his philosophical stance will be investigated. **1**. Logic is required for the correction of scientific language, but analysing the course of events requires probability. « Logic is relevant even to empirical sciences like psychology » (1957, Introd.). « In restricting himself to the concept of constant conjunction, Hume was not fair to the use of causal notions in ordinary language and experience. Roughly speaking, the modification of Hume's analysis I propose is to say that one event is the cause of another if the appearance of the first event is followed with a high probability by the appearance of the second, and there is no third event that we can use to factor out the probability relationship between the first and second event » (1970, p. 10). **2**. Probability is not entirely a subjective matter, as de Finetty wrote - it is objective : « Randomness is in nature, and not simply in our ignorance of true causes » (1984, p. 23, 93). Probability and causality are tied up. **3**. As there is a burgeoning of the research in neurosciences, we will need a new Kant to build a constructive *Kritik* and take us beyond the mind-body problem. « The slow but steady accretion of the case for an empirical view of all human phenomena calls for a revision of much thinking in philosophy that still retains unfortunate remnants needing the kind of critique that Kant gave earlier, but now applied to a wider circle of philosophical ideas ». Finally the intellectual generosity and open-mindedness of Patrick Suppes will be underlined.

SPECIAL SESSIONS

SYMPOSIA

TRUTH AND PARADOX: WITHER THE FUTURE?

Tuesday, August 4 • 11:00–13:00
Main Building, Auditorium II

The past decades have seen intensive research activity on logical and philosophical aspects of truth and the paradoxes. On the logical side, a great number of interesting proof theoretic and semantic approaches to truth and paradox have been proposed. On the philosophical side, the discussion has mostly centered around the deflationist conception of truth.

In all of these areas, new directions of research seem to be called for. On the proof theoretic side, the subject has become very technical. The era of formulating new natural axiomatic truth systems and investigating their proof theoretic strength seems to be closing. One has the feeling that most of the natural systems of truth have been found and studied. On the semantic side, it is no longer clear what the desiderata are for a theory of truth. Securing a transparent notion of truth often comes at the cost of consequences that are counter-intuitive for reasons not always related to truth. And on the philosophical side, one has the feeling that most of the interesting versions of deflationism have been articulated and debated, and that the philosophical discussion has lost some of its momentum.

In sum, it seems that a re-orientation of the field is needed. And in many ways this is already happening. In particular, researchers are starting to relate the concept of truth to other notions that are of logical and philosophical interest, such as conditionals (Field), reflection principles (Ketland) and probability (Leitgeb). Most notably, there is increasing interest on questions surrounding the relation of truth to intensional notions such as necessity or tense (Halbach). It has now become clear that relating such notions to the concept of truth yields deeper insight into them. At the same time, doing so rests on insights that have been obtained in the study of axiomatic and semantic theories of truth and in the discussion of truth theoretic deflationism.

In light of all this, it seems timely and important to devote a special session of the 2015 edition of CLMPS to discussing the current state of affairs in the study of truth. In particular, we want to investigate the ways in which the relation of truth to other notions can be explored, what we already know and what is reasonable to expect. We do this by choosing four themes, explored in four different talks, which we use as our starting points for further discussion. The first talk relates truth to necessity and shows that new paradoxes exert once again limiting force. The second talk reopens the problem of the definability of truth in a novel model theoretic setting where there is more than paradox to worry about. The third shows that full disquotation, which constitutes the motivation for most non-classical truth theories, is not necessary for a truth predicate that fulfils its desirable generalising function. And the final talk discusses the logical relation between Tarski biconditionals and reflection principles, and the implications of this for the philosophical doctrine of deflationism.

We will conclude with a round table discussion with the aim of drawing connections between the above themes and other topics currently undertaken in the study of truth. This will be done with an eye on articulating questions that are open for future research.

Format: four talks each scheduled for 25', followed by 20' round table discussion led by the principal organiser.

Duration of the symposium: 2 hours.

Schedule: Talk 1: Necessities and Necessary Truths Revisited (25') Talk 2: Definability of Truth and Intensional Context (25') Talk 3: Disquotation and Deflationism (25') Talk 4: Reflection, Truth, Entitlement (25') Round table discussion (20')

1. Necessities and Necessary Truths Revisited

Halbach Volker
University of Oxford, UNITED KINGDOM

Pursuing a suggestion by Kripke (1975) and others, Halbach and Welch (2009) considered a reduction of modal predicates to modal operators and a truth predicate: A verb phrase such as is necessary is replaced with the expression is necessarily true that contains only an adverbial phrase for the modality and a truth predicate. I argue that this reduction is hardly acceptable, because it imposes strong constraints in various areas of philosophy and forces strong revisions to certain standard frameworks in philosophical logic, metaphysics and epistemology. I conclude that the operator conception of modal notions such as necessity, apriority, analyticity and provability are not serious options and that they should be treated as predicates. The simultaneous treatment of modal notions and truth as predicates yields expressively rich languages; but it also carries with it the risk of paradox, as Halbach (2006), Horsten and Leitgeb (2001) have observed. Not all of these paradoxes cannot be reduced to the known paradoxes of one predicate as Stern and Fischer (2014) have shown. They threaten many areas of philosophical discourse and may impose severe constraints on theories in epistemology, modal metaphysics and other areas.

2. Definability of Truth and Intensional Context

Achourioti Dora
University of Amsterdam, NETHERLANDS

Semantic truth theories propose different ways of doing away with the paradoxical aspects of truth. What is considered an acceptable solution to the paradox depends on what properties truth is expected to have; for example, whether the truth predicate can be iterated, whether it is fully transparent, whether it licenses or not certain reasoning patterns. Less attention has been devoted on the way a truth predicate interacts with the context in which it is to be defined. We propose to study structures that incorporate variability in the domains and the interpretation of the predicates. Such structures are epistemologically interesting in that they reflect the familiar situation of revising our beliefs and repairing our expectations as we further our knowledge of the world. In this novel setting, definability of a truth predicate for a given sentence is not solely dependent on whether the sentence is paradoxical or not. We argue that a natural way to go is to employ a co-recursive definition, so that the meaning of a truth predicate informs itself by later stages in the acquisition of knowledge. It is no surprise, yet formally interesting, that in such contexts, a truth predicate represents an intensional notion and acquires properties of a modal operator.

3. Disquotation and Deflationism

Schindler Thomas
MCMP and Lavinia Picollo, University of Buenos Aires, ARGENTINA

According to deflationism, the truth predicate would be entirely dispensable save for the fact that it enables us to express certain generalisations. Several authors claim that the truth predicate can serve this function only if it is fully disquotational–i.e. it satisfies the general equivalence between a sentence and its truth predication, which is impossible in classical logic. Accordingly, many non-classical theories of truth have been proposed. In this talk, we propose a concise formulation of what it means for a theory of truth to enable us to express generalisations and examine existing truth theories under this light. It turns out that disquotation is neither necessary nor sufficient to express generalisations: there are many classical truth theories that support the generalising function while a couple of non-classical theories of disquotational truth do not.

4. Reflection, Trust, Entitlement

Horsten Leon
University of Bristol, UNITED KINGDOM

Even though disquotationalism is not correct as it is usually formulated, a deep insight lies behind it. Specifically, it can be argued that, modulo implicit commitment to reflection principles, all there is to the notion of truth is given by a simple, natural collection of truth-biconditionals.

John Burgess published a paper with the title "The truth is never simple" Burgess (1986). What he meant is that the extension of the truth predicate, in a typed and even more so in a type-free approach, is complicated. This cannot be disputed. But we argue that the intension of the truth predicate is simple, in the sense that the content of the concept of truth is given by a simple and natural collection of truth-biconditionals. In other words, we claim that some form of disquotationalism must be in some sense correct. From a logical point of view, this takes us to the area of proof-theoretic approaches to truth, and away from the area of model-theoretic approaches to truth, which was the focus of Burgess (1986).

Arguments by Shapiro and Ketland that are based on observations by Tarski, have shown that certain standard formulations of disquotationalism are untenable. The fact that truth is compositional cannot be fully accounted for by disquotational axioms alone. Moreover, disquotational principles alone do not seem to do justice to the role that truth plays in metamathematical reasoning. In particular, compositional truth principles can be used to show that reflection principles hold and thus to justify reflection principles, whereas disquotational principles are too weak to do this.

Our position in this article is that disquotational principles nonetheless capture the core content of the concept of truth. When reflection principles are applied to (proof- theoretically weak) disquotational principles against the background of a weak syntax theory, strong compositional theories result. And when we are committed to a weak disquotational theory of truth, then we are implicitly committed to reflection principles for it. Therefore the compositionality of truth is implicitly contained in disquotational principles.

References: John Burgess The Truth is Never Simple. Journal of Symbolic Logic, 51:663–681, 1986. Volker Halbach. How not to state the T-sentences. Analysis, 66:276–280, 2006. Correction of printing error in vol. 67, 268. Volker Halbach and Philip Welch. Necessities and necessary truths: A prolegomenon to the metaphysics of modality. Mind, 118:71–100, 2009. Leon Horsten and Hannes Leitgeb No future. Journal of Philosophical Logic, 30:259–265, 2001. Saul Kripke. Outline of a theory of truth. Journal of Philosophy, 72:690–712, 1975. reprinted in Martin (1984). Robert L. Martin, editor. Recent Essays on Truth and the Liar Paradox. Clarendon Press and Oxford University Press, Oxford and New York, 1984. Johannes Stern and Martin Fischer Paradoxes of interaction? Journal of Philosophical Logic, pp. 1–22, 2014. http://dx.doi.org/10.1007/s10992-014-9319-5

SYMPOSIUM TITLE: RATIO AD CONTRARIUM: THE LOGICAL AND PHILOSOPHICAL IMPORTANCE OF REASONING UNDER CONTRADICTIONS

Tuesday, August 4 • 14:30 –16:30
Main Building, Room 10

The paraconsistent paradigm of reasoning, in particular the paraconsistent logics, consists of expanding traditional logic in various ways in order to maintain sensible reasoning under the presence of actual or potential contradictions. It is a remarkable philosophical wonder that a traditional wisdom which concerns the so-called "dialectical reasoning" in Western philosophy, as beautifully summarized by Lao-Zi (or Lao-Tzu, founder of Taoism), " being and nonbeing produce each other", seems to be applicable to contemporary science, from mathematics to computer science and the natural sciences. The interest of developing techniques, as well as philosophical theories, dedicated to tackle the wide question of carrying out reasoning in the presence of inconsistency seems to be a hallmark of the contemporary scientific society. This symposium aims to explore this theme in a broad sense.

Probability measures of the inconsistent-- and of the contradictory

Walter Carnielli
State University of Campinas, UNICAMP, BRAZIL

Popper famously warned, in his "What is dialectic?" of 1940, that "once a contradiction were admitted, all science would collapse". Thus one of the most prominent philosophers of science would never admit positive probability of a contradiction, with good reason: in traditional logic, if one admits to accept A and ~A at the same time, any proposition will be derived from them. But perhaps Popper, as many other philosophers, will have failed to notice that logic and probability are completely dependent: as non-classical logics have flourished nowadays, unless we stick to strict logical monism it is only natural to think on probabilities based on such new logics. A few logicians have already considered, for instance, the possibility of attaching positive values to contradictory propositions, opening the way to paraconsistent probabilities. The same for intuitionistic logic, giving rise to incomplete or default probabilities. I intend to show here how a very natural notion of probability measure can be assigned to the (paraconsistent) Logics of Formal inconsistency, so that distinct contradictory beliefs may have significantly different probability degrees, reflecting the fact that not all contradictions are necessarily equivalent. Moreover, the notion of consistency can also be attached a measure of probability, and the interplay between the notions of contradiction and consistency generalizes the classical instance of probability. This permits one to define a new notion of Bayesian conditionalization, with interesting consequences for the adventure of reasoning, including for the riddles of Quantum Mechanics.

Paraconsistency as evidence preservation: a natural deduction approach

Abilio Rodrigues
Federal University of Minas Gerais, BRAZIL

The acceptance of a pair of contradictory sentences A and not A in paraconsistent logics may be understood as the occurrence of conflicting evidence about the truth value of A. Evidence that A is true (or false), in its turn, may be understood as reasons for believing that A is true (or false). From this point of view, the notion of preservation of evidence presents itself as a topic to be further developed in paraconsistency.

In the BHK interpretation for intuitionistic logic, natural deduction rules preserve of (some sense of) construction. Analogously, we present a natural deduction sentential system designed to express preservation of (some sense of) evidence. The system isparaconsistent and paracomplete, since neither explosion nor excluded middle hold, although double negation equivalence holds.

The inference rules for disjunctions, conjunctions and conditionals are obtained in two steps. First, we ask about the sufficient conditions for having evidence that a given proposition is true. We ask then what would be sufficient conditions for having evidence that a given proposition is false. Each step produce rules whose conclusions are disjunctions, conjunctions, conditionals and negations of these formulas. Once the introduction rules are obtained, we get the elimination rules, as suggested by Gentzen, as 'consequences' of the introduction rules.

Although the system so obtained is able to express the notion of preservation of evidence, and not preservation of truth, by applying the resources of the logics of formal inconsistency, classical logic is recovered with respect to propositions whose truth value has already been conclusively established. Once classical logic is recovered, the system turns out to be able to give also an account preservation of truth. (Joint work with Walter Carnielli).

Der Läufer darf gerade ziehen und der Läufer darf nicht gerade ziehen? Sketches for an anthropological philosophy of paraconsistency, based on the notion of rules

Marcos Silva
University of Ceara, BRAZIL

In Grundgesetze II, Frege (1903) incidentally uses the notion "conflict of rules" ("Widerstreit der Regeln") to explain what contradictions are, when heis critically evaluating some formalist accounts of mathematical practices and entities. In 1930, when Wittgenstein was preparing Waismann for representing him in a very influential panel on the Philosophy of Mathematics to be held in Königsberg, he explicitly borrows from Frege's discussions this notion"conflict of rules" to criticize Hilbert's metamathematical enterprise, especially his account of consistency (Widerspruchsfreiheit). Due to these discussions with members of the Vienna Circle (1929-1932), some authors suggest that Wittgenstein could be held as a forerunner of paraconsistent logics. Indeed, Wittgenstein, during these discussions, and in other texts from the same period, reacts very tolerantly to some non-classical reasoning, especially in the presence of formal contradictions. In this talk, we will not engage in the evaluation of Wittgenstein being a real forerunner for some non-explosive logics, but rather we will investigate why and how the notion of rules in a game could be a seminal philosophical alternative in understanding the nature of contradictions without the appeal to dialetheias. In the beginning of the 30's, Wittgenstein's focus was neither on formal trivialization nor on any mandatory collapse of calculi which entail contradictions, but rather he was already sketching a very comprehensive anthropological account of logic. This account may help us to articulate, through the notion of normativity and rules, the nature of formal systems and the relevance of human practices in the construction of both paracomplete and paraconsistent logics.

On Paraconsistent Belief Revision: the AGM rationality criteria revisited

Rafael Testa
State University of Campinas, UNICAMP, BRAZIL

Belief revision is the process of changing beliefs to take into account a new piece of information. The AGM system, a most influential work in this area of study, adopts the following rationality criteria: (1) when possible the belief set should remain consistent; (2) any sentence logically entailed by beliefs in a set should be included in it; (3) when changing beliefs, loss of information should be kept to a minimum; (4) beliefs held in higher regard should be retained in favor of those held in lower regard.

The strong relation among those criteria will be discussed. The focus is to present the AGM-like systems of Paraconsistent Belief Revision developed by the authors, and to discuss the concept of rationality captured by those systems. By permitting the reasoning from contradictory belief sets, Paraconsistent Belief Revision offers more flexible ways of revisions, expounding the important opposition between consistency and minimality (concerning the first and third criteria respectively).

SOCIAL EPISTEMOLOGY: RESEARCH TEAMS AND SCIENTIFIC COMMUNITIES

Tuesday, August 4 • 14:30–16:30
Main Building, Auditorium II

In this symposium we explore the connections between the social epistemology of research teams and the social epistemology of scientific communities. Much of the literature on the social epistemology of scientific knowledge focuses on scientific communities, thereby ignoring research teams. For example, some social epistemologists defend norms which characterize ideal epistemic communities (see e.g., Longino 2002). Some others are concerned with an ideal distribution of research efforts in scientific communities (see e.g., De Langhe 2010; Kitcher 1993; Solomon 2001; Zollman 2010). In our view, the social epistemology of research teams deserves more attention than it has received so far. Many scientists work in research groups and publish their findings in multi-authored articles (Galison 2003; Wray 2002, 2006). Scientific collaboration is often a practical necessity because the production and analysis of evidence is too expensive and time-consuming for any individual scientist to accomplish independently (Hardwig 1991; Wagenknecht 2013). Sometimes collaboration becomes a necessity because a research project draws on a variety of expertise from different disciplines (Andersen and Wagenknecht 2013; Thagard 1999). In such cases, a research team with a division of labor is capable of carrying out a project that no individual scientist could do on their own.

Acknowledging the importance of scientific collaboration has led many philosophers to examine its implications for the social epistemology of scientific knowledge. Some philosophers suggest that scientific knowledge emerging in collaborations involves collective beliefs or acceptances (Andersen 2010; Bouvier 2004; Cheon 2013; Gilbert 2000; Rolin 2010; Staley 2007; Wray 2006, 2007). Some others suggest that the epistemic structure of scientific collaboration is based on relations of trust and interactions among scientists (Andersen and Wagenknecht 2013; Fagan 2011, 2012; Frost-Arnold 2013; Hardwig 1991; Kusch 2002; de Ridder 2013; Thagard 2010; Wagenknecht 2013, 2014). In the former case, a research team is thought to arrive at a group view which is not fully reducible to individual views. In the latter case, each team member is thought to rely on testimonial knowledge which is based on her trusting other team members.

These two accounts of the epistemic structure of scientific collaboration give rise to novel research questions. For example, given the collective acceptance account, one may wonder whether the phenomenon of groupthink threatens to undermine the epistemic benefits of scientific collaboration (Solomon 2006; Tollefsen 2006; Wylie 2006). And if it does, what forms of social organization can best counter the epistemic dangers of groupthink (Wray 2014)? Given the trust-based account, one may wonder whether rational trust among collaborating scientists is best explained in terms of moral values or self-interests (Frost-Arnold 2013). How are relations of trust managed in the actual practice of scientific collaboration (Andersen 2014; Rolin 2014; Wagenknecht 2014)?

The four symposium participants explore these questions by discussing the distribution of labor in research groups, the Matthew effect in research groups, the distribution of epistemic responsibilities in research groups and scientific communities, and the tensions between the social epistemology of research groups and the social epistemology of specialties.

Joint Commitments and the Distribution of Labor in Research Groups

Andersen Hanne
Aarhus University, Aarhus, DENMARK
Andersen Line E.
Aarhus University, Aarhus, DENMARK

Most new knowledge in science today is produced by groups in which scientists collaborate in order to share knowledge, manpower, materials, or other scarce resources. Often collaborators will differ in their area of expertise, and epistemic labor in the group will be divided accordingly. Nevertheless, this division of labor within groups has often been overlooked in analyses of science from a social epistemology perspective.

In this presentation I shall start from Margaret Gilbert's analysis of joint commitments in scientific groups. I shall argue that Gilbert's analysis overlooks the importance of division of labor and deference to expertise. Extending Gilbert's account to accommodate the division of labor, I shall argue that a group's joint acceptance of a new scientific claim is often based on group-based justification where elements of the justification are distributed among members in the group according to their area of expertise. Consequently, scientific change requires that a new group-based justification for the changed view is produced, and this again requires either renewed deliberations in the group, or the formation of an alternative group in which a justification of the revised view can be established. Further, I shall argue that an individual group member who rescinds his or her commitment to the group gives up a more general shared intention that was held together with the other members of the group, and that this plays a separate role in the process of change. Finally, I shall argue that on this interpretation one need not be as pessimistic with respect to the possibility of scientific change as suggested by Gilbert.

The Matthew Effect and Trustworthiness in Research Teams

Karen Frost-Arnold
Hobart and William Smith Colleges, UNITED STATES

This paper provides a social epistemology of the Matthew effect by analyzing the virtue of trustworthiness in research teams. In the Matthew effect, as introduced by Robert Merton (1973/1968; 1988), eminent scientists receive more attention for the same discovery made with (or by) a less well-known scientist. Much of Merton's evidence for the Matthew effect comes from Harriet Zuckerman's (1977) interviews with Nobel Prize winners, some of whom worry that it represents an unjust pathology in the reward system of science. As a result, eminent scientists sometimes refuse to attach their names to research done in collaboration with junior colleagues.

Michael Strevens (2006) argues that the Matthew effect is not pathological, but instead epistemically beneficial, on the grounds that it draws the community's attention to the best research. Thus, Strevens concludes that eminent scientists who attempt to negate the Matthew effect are themselves potentially creating a pathology in the system. Strevens' analysis models scientists as purely self-interested agents. I argue that this self-interest approach misses key insights from social epistemology. Focusing on the moral and epistemic virtue of trustworthiness provides a better explanation of the epistemology of the effect.

The Matthew effect unfairly harms junior scientists, and this systemic injustice places senior scientists in a dilemma if they wish to be trustworthy colleagues. This injustice is not just morally problematic; it also does epistemic damage by making junior/senior collaboration risky for junior colleagues. Scientific collaboration has many epistemic benefits (Hardwig 1991; Thagard 1997; Wray 2002; D'Agostino, 2008; Frost-Arnold 2013), and junior/senior collaborations are particularly valuable (Merton 1973/1968). Thus, when senior scientists resist the Matthew effect by removing their names from team publications, their actions may, contrary to Strevens' analysis, be beneficial by encouraging epistemically valuable collaboration.

The Distribution of Epistemic Responsibilities in Scientific Communities and Research Groups

Rolin Kristina
University of Helsinki, FINLAND

In my presentation I focus on the epistemic responsibilities a scientist has in virtue of being a member of a scientific community and I discuss the question of how such responsibilities relate to the ones a scientist has in virtue of being a member of a research group. By the term epistemic responsibility I refer to a particular kind of moral duty, a duty to be epistemically responsible in one's knowledge claims. An individual scientist is epistemically responsible in making a knowledge claim when she provides sufficient evidence in its support or adopts it with a defense commitment (Rolin 2011; Williams 2001).

In the first section I review some classical conceptions of scientific community (e.g., Polanyi 1951; Kuhn 1962) as well as Tilmann Massey's (2013) notion of epistemic interest community, and argue that they do not offer an adequate account of the social glue that binds the community members together. I argue that a moral duty to be epistemically responsible is the social glue. In the second section, I argue that the duty to be epistemically responsible should be understood as a special moral duty, that is, a duty we have toward particular individuals because they stand in some special relation to us (e.g., a member of a research group or a member of scientific community). I draw on Robert Goodin's (1988) political philosophy to argue that special moral duties derive their normative force from general moral duties, that is, the duties all human beings have toward all other human beings. However, general moral duties can be implemented only by assigning special moral duties to some people thereby creating a division of moral labor. In the third section I argue that both research groups and specialties play an important role in determining how epistemic responsibilities are distributed in science.

Two Senses of Social in Social Epistemologies of Science

Wray K. Brad
SUNY Oswego, UNITED STATES

The topics addressed in the social epistemology of science are wide-ranging (Wray 2013). Some disagreements in the literature seem to be due to the equivocal way in which the term "social" is used. Schmaus (2008) and Cheon (2014) have already alerted us to this concern. I distinguish between two different types of projects in the social epistemology of science by distinguishing between two different uses of the term "social." In studies of collaborative research, the term "social" is meant to denote that the group rather than the individual scientist is the unit that holds the views published in articles (see Wray 2007; Rolin 2008; Andersen 2010). That is, the view of the research team may not be identical to or reducible to the view of the individual members of the team. In studies of scientific specialization the group is also the unit of analysis. But instead of emphasizing the unity and homogeneity of the group, in these studies the group is characterized by the variability among the members of the specialty community. Like a biological species, a research specialty is composed of individual scientists who are different from each other, often in subtle but important ways. The variability in the research community is exploited to meet challenges that the group inevitably confronts (see Kuhn 2000; Wray 2011).

These different projects in the social epistemology of science give rise to very different research problems. In the literature on collaborative research, a central concern is to understand how to prevent homogeneity in thinking as the group aims for consensus. Research teams risk falling prey to groupthink, prematurely reaching a consensus (see Solomon 2006; Wray 2014). In the literature on specialization, on the other hand, a central concern is to understand how such groups maintain cohesion, given that they are characterized by variability.

THE ROLE OF ABSTRACTIONS AND GENERALIZATIONS IN SYSTEMS AND SYNTHETIC BIOLOGY

Tuesday, August 4 • 14:30–16:30
Main Building, Room 15

The use of highly abstract and general mathematical models in biology has been a subject of a longstanding philosophical and methodological discussion. It has seemed to many that details and particularities matter so much in biology that it is not as amenable to mathematical modeling as many other natural sciences. This is also reflected by the dominant account of explanation in philosophy of biology, the new mechanistic philosophy. According to it, mathematical models are merely sketches or schemas because of their abstract, general nature that leaves out, or underspecifies, many parts and operations of a mechanism. At best they can offer general how-possibly explanations falling short of a how-actually explanation of a real mechanism. Recently, a group of mechanistic philosophers has argued that the aforementioned mechanistic view does not duly recognize the important role of mathematical modeling in accounting for the dynamic aspect of biological organization (Bechtel and Abrahamsen 2011, Bechtel 2011, Levy and Bechtel 2013, Levy 2013). According to them biological models typically abstract from details in order to study the effects of non-linear interactions between components.

While Bechtel (2011) and Bechtel and Abrahamsen (2011) were still optimistic about the possibility of recomposing the (usually experimentally) decomposed elements of a mechanism into a general mechanism of their interaction, in later work they have come to realize that such realistic representation of a mechanism may not be the goal of modeling (Levy and Bechtel 2013, Levy 2013). In contrast, the modelers' attempt to abstract from the details of a mechanism may constitute a successful explanatory strategy in its own terms.

The purpose of this symposium is to evaluate these claims concerning the role of abstraction and generalization in modeling biological systems. We will concentrate on systems and synthetic biology, which are relatively new areas of study, relying heavily on mathematical modeling. The questions addressed include: How can we account for the use of formal interdependencies and generic organizational features within systems and synthetic biology in particular, and the life sciences in general? How are such abstractions arrived at in the process of modeling? How should we understand the how-possibly character of many biological models? Is there any other way to approach such abstractions than considering them deficient explanations? How are the models of gene-regulatory and metabolic networks fitted to a given dataset through simplification and abstraction? Our approach is practice-oriented and partially case-based, including also empirical data on scientific research.

References: Bechtel, W. 2011. "Mechanism and Biological Explanation." *Philosophy of Science* 78: 533-557. Bechtel, W. and Abrahamsen, A. 2011. "Complex Biological Mechanisms: Cyclic, Oscillatory, and Autonomous." In *Philosophy of Complex Systems. Handbook of the philosophy of science*, vol. 10, ed. C.A. Hooker, 257–285. Oxford: Elsevier. Levy, A. and Bechtel, W. 2013. "Abstraction and the Organization of Mechanisms." *Philosophy of Science* 80: 241-61. Levy, A. 2013. "What was Hodgkin and Huxley's Achievement?", *The British Journal for the Philosophy of Science*, doi:10.1093/bjps/axs043

How to Understand Abstraction in the Modeling of Complex Systems?

Knuuttila Tarja
University of South Carolina and University of Helsinki, FINLAND
Loettgers Andrea
University of Geneva and University of Bern, SWITZERLAND

The prevalent view on abstraction among philosophers of science is that of omission. Whereas idealizations are thought to introduce distortions into a scientific representation, abstraction is understood in terms of abstracting away from the details of a system of interest. In this vein, in a series of recent articles on abstraction and modeling, Levy and Bechtel claim that a scientific model is a highly selective depiction of some underlying mechanism that takes into account only those features that make a difference (in causal terms).

We agree with the general thrust of Levy and Bechtel's analyses, especially with their emphasis on the use of general mathematical models to study the non-linear features of biological systems consisting of several interacting components. However, we will argue that the idea of abstraction as omission does not capture what goes on in actual *model construction*. Such an account of abstraction implies that model construction would be a process that proceeds from a (specific) mechanism whose details (known and unknown) are abstracted from in order to attain a (general) mathematical model. Yet, more often than not, modelers start instead from a general *model template* that is then tailored to fit the phenomenon in question. We argue that from the perspective of modeling heuristic one should make a distinction between the cases in which one selects between components and possible interactions and those that start from an abstract mathematical mechanism that describes a general pattern of interaction. Paying attention to this difference gives us a better grasp on what happens in mathematical abstraction. We will illustrate this point by examining the construction of models of gene-regulatory networks, which provide a central example for Bechtel and Levy.

Constraint-based Reasoning and Mechanistic Explanation

Green Sara
University of Copenhagen, DENMARK

Life scientists increasingly rely upon mathematical modeling and abstract reasoning strategies for managing and understanding biological phenomena such as robustness. I introduce the notion of constraint-based reasoning as a fruitful tool for conceptualizing some of these developments. One important role of mathematical abstractions is to guide biological research by narrowing down the search space for possible mechanisms to explain a given phenomenon. In such cases, formal constraints can organize hypothesis search by defining the set of plausible models of causal processes operating in concrete systems. Sometimes, however, the delineation of the space of possibilities from formal principles can itself be explanatory, by clarifying why particular mechanisms belong to certain structural types. In systems biology, reasoning about such categorizations often refer to general 'design principles' or 'organizing principles'. This raises the question of how such reasoning styles relate to mechanistic accounts.

I examine two roles that design principles play in systems biology and argue that these are involved in two complementary styles of reasoning. First, they play heuristic and explanatory roles in mechanistic reasoning for explaining concrete biological systems. Secondly, I introduce the notion of *constraint-based explanations* to highlight a more abstract form of theorizing. While mechanistic explanations emphasize change-relating causal features, constraint-based explanations emphasize formal dependencies and generic organizational features that are relatively independent of lower-level changes in causal details. Furthermore, I show how the notion of constraint-based explanation helps to identify features common to otherwise different philosophical accounts of abstract explanatory strategies in biology. The distinction between mechanistic and constraint-based explanations is pragmatically motivated by the wish to understand scientific practice. Delineating the affordances and assumptions of different explanatory strategies also helps to clarify tensions between diverging scientific practices, and the innovative potentials in combining different explanatory strategies.

Synthetic Biology and the Search for Potential Biological Systems: Taking How-Possibly Models Seriously

Koskinen Rami
University of Helsinki, FINLAND

Mechanistic explanation in biology typically proceeds by constraining the space of possible mechanisms for a given phenomenon or function. According to Craver (2007), the space of possible mechanisms contains all the mechanisms that could possibly explain a phenomenon. By explicating a particular point in this space, scientists construct what philosophers of science term a how-possibly explanation or model. How-possibly models are usually treated as some kind of second-rate explanations. Possible mechanisms are conceptualized as mere vague schemas that arise from abstract mathematical modeling that is insensitive to biological details. Such models may be inevitable in the early stages of theorizing, but don't constitute what can be viewed as the main aim of explanation, namely, the discovering of a one true mechanism responsible for the phenomenon under study.

I argue that this current view concerning the role of how-possibly models is very narrow. More precisely, it may be a good approximation in the context of scientific analysis of natural systems where research advances through the methods of decomposition and localization (Bechtel and Richardson 2010). However, it doesn't do justice to the synthetic strategy that is commonly used in the engineering sciences.

In the field of synthetic biology, researchers use how-possibly models to study what may be called potential biological systems. I argue that in the hands of bioengineers, abstract how-possibly models are not something to be eliminated by a more detailed analysis, but rather blueprints for a field whose ultimate goal is to build novel biological systems. I explicate this role further by providing examples from synthetic biology research that show how the method of synthesis, even when it fails, provides an effective way to limit the space of possible biological mechanisms. This has effects for the study of potential and actual natural systems alike.

Reevaluating the Goals of Systems Biology: Abstraction and Uncertainty

Miles MacLeod
University of Helsinki, FINLAND

In this talk I argue that the various abstractive and simplification techniques that systems biologists use to build models of gene-regulatory and metabolic networks generate uncertainty over the representational capacities of their models. Results of an ethnographic study demonstrate just how many layers of simplification and abstraction are employed by modelers to obtain models that fit a given dataset. Uncertainty extends from the noiseness and insufficiency of the data used to build models, as well the basic biovariability of such systems, to the inability with current technology to measure many parameters required for dynamic models. Sensitivity analysis and global fitting process are extensively relied upon to fit models but there is considerable capacity for parameters to compensate one another's errors. As such models may be contrived to fit the data well using these abstractive data-simplifying and calculation processes, the combination of these techniques render it quite uncertain to what extent a model can actually be relied upon for generating robust predictions.

It is a well stated aim of systems biology to provide both good representations of the structure and mechanisms of systems and produce robust reliable models that afford control over biological systems. The two are not exclusive since a good mechanistic representation should imply predictive accuracy. In reality neither goal is being currently achieved on a wide scale. It is uncertain to which extent globally fitted models, relying on numerous abstractions and inferential techniques many of which skew a model towards accounting for only particular dynamical relations (not the system as a whole), can be said to represent the mechanism of a system. What seems to be required as such is a more nuanced understanding of what the goals of systems biological modeling are that make sense of what is actually being produced in current practice.

EPIDEMIOLOGICAL PRACTICES? AN INTEGRATIVE APPROACH TO EPIDEMIOLOGICAL CAUSAL REASONING

Tuesday, August 4 • 17:00–19:00
Main Building, Auditorium II

Estany Anna
Universidad Autónoma Barcelona and Andreu Ballús,
Universidad Autónoma Barcelona, SPAIN
Aliseda Atocha
Universidad Nacional Autónoma México, MEXICO
Casacuberta David
Universidad Autónoma Barcelona, SPAIN
Vallverdú Jordi
Universidad Autónoma Barcelona, SPAIN

This symposia aims at contributing to the philosophical analysis of medical knowledge, on its reasoning patterns in the practice of the so called --clinical reasoning—as well as on the analysis of some key concepts in the Philosophy of Science, in this case, that of causality in its role in epidemiology. The main aim of this symposium is to discuss the type of epistemological knowledge involved implied when doctors perform develop clinical reasoning in order to diagnose an illness and further to find its appropriate a proper treatment for it. Distinguishing causes from correlations is a key part of that process of reasoning, so it will give a different perspective to view classical philosophical problems about causation.

The symposium is divided into four parts: the first one Medicine as design science (Estany & Ballús) is a general discussion on medicine as a design science, a type of scientific inquiry oriented to understand the world as well as to change it. It is important to keep in mind this double role?, as an applied as well as a theoretical discipline? nature of medicine, in order to get a proper understanding of what clinical reasoning is about. This view of medicine as a design science is endorsed by each and every paper to follow and therefore serves as the basis for our discussion.

Next talk Clinical Reasoning: How to go about it? (Aliseda) will focus on the general traits and epistemological questions that clinical reasoning brings about. There will be an analysis of the main reasoning types one can find in clinical reasoning and of the philosophical and epistemological questions that arise in the medical profession. This view is supported by some field analysis –in so far the presence at clinical sessions at a Research Neurological Hospital can be considered as such—as well as a formal analysis of the argumentative process in clinical reasoning.

The last two talks will focus on the science of epidemiology to analyze the relationship between causal and clinical reasoning, and its relationships with e-science: how scientific method evolves when computers are used extensively in the research process. The third talk, Data visualization as a form of graphic medical reasoning to find causal correlations (Casacuberta) , will analyse a very specific type or clinical reasoning, the argumentative process based on graphic visualization -normally created by computers- as developed in epidemiology.

The last talk Statistics or Web of Statistical Procedures in Epidemiological Practices? An Integrative Approach to Epidemiological Causal Reasoning (Vallverdú) analyzes how the type of statistical tool needed to make causal inferences in epidemiology greatly depend on the complexity of the situation to study, and how analyzing a web of different causes is changing our view of what is causality and what does it entail epistemologically.

SYMPOSIUM ON DANIELLE MACBETH'S REALIZING REASON: A NARRATIVE OF TRUTH AND KNOWING (OXFORD UP 2014)

Tuesday, August 4 • 17:00–19:00
Main Building, Room 12

CHAIR:
Reck Erich
University of California, Riverside, UNITED STATES

CRITIC 1
Kennedy Juliette
University of Helsinki, FINLAND

CRITIC 2
Ferreirós José
University of Seville, ITALY

AUTHOR:
Macbeth Danielle
Haverford College, UNITED STATES

This symposium focuses on BOOK (Oxford University Press, 2014) and takes the form of an author-meets- critics session. There will be two speakers, each speaking for thirty minutes, with the author responding, forty minutes, followed by a twenty-minute open question period. The overall aim is to open up new vistas for thinking about current philosophy of logic and philosophy of mathematics, and to show how they might be enriched by reflecting on how logic and mathematics came to be what they are today.

BOOK pursues three interrelated themes. First, it traces the essential moments in the historical unfolding— from the ancient Greeks, through Descartes, Kant, and developments in the nineteenth century, to the present —that culminates in the realization of pure reason as a power of knowing. Although reason makes its first appearance as a critically reflective capacity, it is only through this history of transformation and growth that it becomes a source of knowledge. Second, BOOK develops a cogent account of mathematical practice as a mode of inquiry into objective truth. It is shown how, through the course of its historical development, mathematical practice itself comes to provide the resources that we need in order to understand it as a science properly speaking. And finally, BOOK develops and defends a new conception of our being in the world, one that builds on and transforms the now standard conception according to which our experience of reality arises out of brain activity due, in part, to merely causal impacts on our sense organs. The author shows that to achieve an adequate understanding of the striving for truth in the exact sciences we must overcome this standard conception and that the way to do that is through a more adequate understanding of the nature of mathematical practice and the profound transformations it has undergone over the course of its history, the history through which reason is first realized as a power of knowing. Because we can understand mathematical practice only if we attend to the systems of written signs within which to do mathematics, the author also provides an account of the nature and role of written notations, specifically, of the principal systems that have been developed within which to reason in mathematics: Euclidean diagrams, the symbolic language of arithmetic and algebra, and Frege's concept-script, Begriffsschrift. As the author argues, all these systems of written signs, each in its own way, enable one to formulate the contents of mathematical concepts in a mathematically tractable way, that is, in a way enabling one to reason in the system of signs.

CRITIC 1

My remarks will focus on the author's fascinating chapter 6 of her text, called "Mathematics and Language," the chapter in which her case is argued from the point of view of 1.) an interpretation of quantifiers in formal languages 2.) the model-theoretic conception of language 3.) meaning and truth 4.) the role of writing in mathematical reasoning and 5.) the ideal of a universal language.

The author's conception of logic's developing role in foundations sees it in essentially Kantian terms, and takes as fundamental a kind of proto-distinction between syntax and semantics---a distinction which would reach full clarification only with Goedel's 1929 Completeness Theorem. In my remarks, I will treat this particular line of thought, branching out into a general critique of the book's central argument.

The author's penetrating and provocative observations here construct a thread from formal modes of quantificational reasoning---for example, according to her, "restricted quantification [i.e. to a specific domain], then, is logically prior to unrestricted quantification"---to the conclusion that

> "...problems arise because we make substantial metaphysical assumptions in logic, both about the nature of thinking and about the nature of language...The model theoretic conception of language...took many, many decades and a great deal of hard work on the part of many brilliant minds to hammer out this conception of language...Technically it has many virtues. Philosophically it has proven a dead end. Mathematical logic does not provide, or even enable, the understanding we seek."

A dichotomy is set up between Verstand and Vernunft, against a conception of mathematical reasoning which finds it ungrounded by "an absolute distinction between logical form and semantic content, and an understanding of meaning in terms of truth—and by way of an understanding of quantifiers, of truth ultimately about objects."

CRITIC 2

My part will be devoted to a commentary on two key components of the author's analysis and reconstruction of mathematics: her study of Euclidean diagrammatic practice (chap. 2) and of reasoning in

Frege's Begriffschrift (chap. 7). Crucial in both cases is the character of ampliative reasoning that the author finds not only in Greek proofs (where it may be more evident), but also in Frege's system—in contradistinction to formal logic, modern logic, which she regards as merely explicative. For Greek geometry, the thesis is that diagrams formulate the contents of concepts, and the construction or diagram thus becomes the site of the reasoning (merely accompanied by text glossing it). In the case of Frege's concept-script, she argues that it is a language designed for reasoning deductively from defined concepts, a concept-language ideally suited to displaying the novel style of reasoning characteristic of modern mathematics since the 19th century.

Her reconstruction of these ingredients plays a central role in the argument why the emergence of modern mathematics is to be understood as a realization of the power of Reason to afford knowledge and with it access to truth.

I will consider both of them critically. In the case of Greek geometric proofs, I will defend that text plays a more central role than seems to be acknowledged by the author, both due to the complexity of the arguments and to the necessary role text plays in formulating assumptions about magnitudes. As regards Frege's Begriffschrift, I will consider the question of the role played by the underlying notions of object, relation and function, which seems to me to deserve more extensive treatment, and their possible connection to how Frege's system functions in articulating structural mathematics.

AUTHOR'S RESPONSE

Much of what we currently, explicitly understand about the domain of logic is little more than a century old, and has complex ties to developments in 19th century mathematics. My remarks will aim further to situate current conceptions of logic within the history of mathematical practice, and to explore the practice of mathematics itself in greater depth.

Over the course of the 20th century it became clear that mathematical logic is of little use either to practicing mathematicians or to philosophers concerned to understand that practice. Chapter 6 aims to provide a diagnosis of this surprising fact and does so in large part, as the first critic notes, by seeing that logic as essentially Kantian. In my response to this critic I aim to clarify further what it means to say that mathematical logic is Kantian and why that might render it unfit as a resource either in contemporary mathematical practice or in contemporary philosophical investigations into mathematical practice. I will be concerned in particular to reflect on the distinction of syntax and semantics on which this critic rightly focuses.

The second critic focuses on the account developed in BOOK of mathematical practice in Euclid and in Frege. I agree with this critic that the text is ineliminable in a Euclidean diagrammatic demonstration, but will nonetheless try to clarify further the central idea that the diagram is the site of reasoning, not the text. The question of the role of the larger mathematical, philosophical, and logical context in the workings of Frege's language Begriffsschrift is also raised. Here what I think is needed is greater attention to the philosophical context coming out of the 18th and early 19th centuries and its connections to 19th century developments in mathematical practice.

MODELS AND PLURALISM IN THE HEALTH SCIENCES

Wednesday, August 5 • 11:00–13:00
Main Building, Auditorium IV

Remarkable progresses in the biomedical sciences in the last decades have led to increased awareness that most diseases are complex, and that their onset and course are often difficult to represent and explain. This has prompted two responses in the health science research community. One is a tendency towards pluralism: an increasing tendency to see diseases and other health states as complex, multifactorial, and generally resistant to being subsumed under a single, general, unifying explanation. The other is an increasing interest in developing models in various domains—of diseases, of crucial mechanisms, and of causal structures, for example. The two tendencies are both responses to an increasingly complex information environment, but in some ways they are at odds with one another, since modeling is usually an attempt to achieve useful simplification, while the other trend—towards admitting complexity—tends to deny that simplification is useful.

We label these two trends the pluralism and modeling trends. Between these two very broad trends in the health sciences—the modeling trend and the pluralism trend—we offer four papers that deal with various aspects of this tension. Paper 1, "Representing and explaining: On modeling disorders" focuses on mechanistic models and their explanatory import. The paper points out that the identification of the explanandum is itself contentious in seeking to explain, and employs examples from neuropsychiatry and cancer research to address the co-evolving of descriptive and explanatory processes in modeling disorders. Paper 2, "Questioning the usefulness of mechanistic models for predicting which medical treatments will benefit humans" argues that the usefulness mechanistic models for discovering treatments that benefit patients has been greatly exaggerated. Paper 3, "DAGgers at dawn? Understanding the potential outcomes 'revolution' in epidemiology", asks what recent developments in causal inference techniques in epidemiology really amount to. The paper argues that "causal models" are neither necessary nor sufficient for good causal inference, which remains a messy, informal business, even with the advent of powerful formal modeling tools. Paper 4, "Pluralism in research on PTSD: Implications for clinical practice", explores the use of pluralistic approaches to investigating post- traumatic stress disorder, and their potential implications for clinical practice.

Format: 4 papers, 20 minutes each plus 10 minutes discussion, tot: 120 min.

Representing and explaining: On modeling disorders

Raffaella Campaner
Department of Philosophy and Communication, University of Bologna, Bologna, ITALY
Bertolaso Marta
University Campus Bio-Medico , Roma, ITALY

This contribution focuses on modeling disorders, and, more specifically, on mechanistic models of disorders and their explanatory import. We address some issues arising from mechanistic modeling of disorders that remain still poorly understood and that are investigated from different, and often distant, disciplinary standpoints.

One particularly thorny problem in the elaboration of explanatory models is the exact identification of the explanandum. In the case of many puzzling disorders, we do not start from a single, accurate and complete description of the system under investigation. The elaboration of the explanatory model rather starts from the choice of a set of characterizing features of the target system, which can be regarded as an array of inter- regulatory subsystems. In the process, any progress in mechanistic understanding of some level further constrains the space of possible mechanisms underpinning the disorder, with descriptive and explanatory processes co-evolving, and correcting each other.

This contribution focuses on the mutual interaction of descriptive and explanatory processes as they de facto occur in medical contexts. We shall highlight some distance between the philosophical debate on mechanistic models and how disorders are actually – and always tentatively – modeled, and the need of further conceptual tools to give justice to the dynamics of modeling disorders at the crossroad of known and unknown systems. The talk addresses such aspects, stressing how the field in which the investigation is pursued and its purpose shape the kind of questions raised, the methods and tools employed to answer them, and the sort of answers accepted. Some specific examples from neuropsychiatry and cancer research are offered to clarify the continuous and iterative processes at play between biomedical research and clinical practice to identify and describe pathogenetic mechanisms, showing some limits of the mechanistic philosophy in effectively capturing such processes.

Questioning the usefulness of mechanistic models for predicting which medical treatments will benefit humans

Howick Jeremy
University of Oxford, Oxford, UNITED KINGDOM

Roughly 70% of money spent on medical research is spent on basic science (animal, in vitro) studies that investigate the mechanisms of health and disease. The justification for spending the majority of research money on more basic science rather than studies that have a more direct impact on human health (such as randomized clinical trials) appears to be that the more basic mechanisms research eventually leads to treatments that benefit humans.

While there are many important and widely celebrated cases where clinically beneficial treatments have been developed on the back of mechanistic models, empirical evidence suggests it happens far less frequently than is generally believed. The reason for the exaggeration is that the theoretical and empirical problems with evidence of mechanisms are persistently ignored. Moreover when it comes to methods for treatment discovery, mechanism research is not the only – or, as I shall argue, most efficient – game in town. The other method is empirical observation.

To anticipate, I begin by describing how basic mechanistic research might, in principle, help generate hypotheses about treatments that will benefit humans. In brief, the argument is that if we have evidence of a mechanism linking an intervention with a clinically relevant outcome, then the intervention is likely to benefit humans. I then point out problems with (a) the reliability of evidence of mechanisms, (b) the stability of mechanisms, and (c) inferences from evidence of one mechanism to claims that an intervention will have a net benefit for patients.

DAGgers at dawn? Understanding the potential outcomes 'revolution' in epidemiology

Broadbent Alex
University of Johannesburg, Johannesburg, SOUTH AFRICA

There is an ongoing "methodological revolution" in epidemiology, according to some commentators. The revolution is prompted by the development of a conceptual framework for thinking about causation called the "potential outcomes approach", and the mathematical apparatus of directed acyclic graphs (DAGs) that accompanies it. These graphs and accompanying "structural equations" allow "causal models" to be constructed. In principle, these enable testable quantitative predictions to be calculated where previously they would not have been calculable.

In epidemiology, the revolutionaries have made remarkable claims, both positive and negative: positively, that stubborn old problems can be solved; and negatively, that stock causes acknowledged by epidemiology—such as race or sex—are not, properly speaking, causes. In this talk, I seek to understand the real significance of this "revolution". Specifically, I ask whether these methodological developments are truly revolutionary, in the sense of replacing what went before, or whether they are methodological developments that supplement but do not replace older, vaguer heuristics for assessing causality, such as Hill's famous "nine viewpoints". Do epidemiologists need causal models for causal inference, and if so, do they need anything besides causal models?

In reaching the conclusion that the "revolution" is not—or ought not to be—successful, I press two main claims. First, I seek to dismantle the strong and unwarranted metaphysical commitments about the nature of causation that the revolutionaries espouse—commitments leading to the startling conclusion that race and sex, for example, are not causes for epidemiological purposes because they cannot be manipulated. I counter that they remain of central importance in epidemiology. Second, I argue that causal models are neither necessary nor sufficient for good causal inference. They offer a useful additional tool, but not a whole new toolkit for causal inference.

Pluralism in research on Post-traumatic Stress Disorder: Implications for clinical practice

Bluhm Robyn
Old Dominion University, Norfolk, CANADA

Philosophers of science have recently begun to address the implications of pluralism in science. For example, Helen Longino (2013) has recently surveyed the many scientific approaches used to study aspects of human behavior and has concluded that, while each of the approaches is , because they are so radically different from one another, they cannot be integrated to develop a single comprehensive account of the phenomenon of study. She further concludes that most sciences will exhibit this kind of pluralism.

If Longino is correct, the prospects may be dim for using science to inform practical or policy endeavors. This is particularly true for medicine, which now emphasizes the importance of basing clinical practice on high quality research evidence; in the absence of scientific unity, it is not clear which approaches or models should inform practice. And in the case of psychiatry, which struggles to be seen as scientific, it is an even greater challenge. In this talk, I use an extended case study of research on post-traumatic stress disorder (PTSD) to investigate the implications of scientific pluralism for psychiatry. PTSD has been extensively studied in humans and in animals using a variety of distinct models (e.g., the fear conditioning model, the cognitive model, and, most recently, a model positing a dissociative subtype of the disorder). I consider the evidence offered in support of each of these models to determine whether they converge on a plausible mechanism (or mechanisms) underlying the disorder. I then (1) examine whether they exhibit the kind of irreducible pluralism that Longino predicted and (2) consider the implications of using these different models for clinical decision-making with regard to diagnosis, prognosis, and treatment.

NAMING LOGIC(S)

Wednesday, August 5 • 14:30–16:30
Main Building, Room 3

Organizer:
Beziau Jean-Yves
Federal University of Rio de Janeiro, BRAZIL

General description of the symposium

The idea of this symposium is to discuss the names used to qualify logic and/or the names for the different (classes of) logic systems.

Modern logic has been qualified in various ways: "symbolic logic", "formal logic", "mathematical logic". What does all this mean? For example "mathematical logic" is typically an ambiguous expression since it can mean both logic treated in a mathematical way or/and the logic of mathematics. "Symbolic logic" is also a mixture of different things. It can make reference to the use of some formal mathematical signs, or some pictures like Venn's diagrams. "Formal logic" is an expression put forward by Kant but ironically it has been often used to denote modern mathematical logic by opposition to traditional logic.

Concerning the names of systems of logic, there is also a lot of ambiguity. In which sense is classical logic "classical", intuitionistic logic "intuitive", linear logic "linear", relevant logic "relevant", free logic "free", minimal logic "minimal?

Talks of this symposium will try to answer some (not all) of these questions. This is part of an international research project.

What makes symbolic logic "symbolic"?

Moktefi Amirouhe
Tallinn University of Technology, ESTONIA

In the late nineteenth century and early twentieth century, the theory of logic knew significant developments that led to what is commonly known as "modern logic". Several names were coined to name this new science: "algebra of logic", "mathematical logic", "symbolic logic", "logistic", etc. This picture reflects the heterogeneity of these early investigations carried out by logicians who were often isolated and were competing with each other as to the best logical system and notation. It is much later than the new logic was established as a discipline on its own and logicians formed a community with the foundation of the *Association for Symbolic Logic* in 1936. The expression "symbolic logic" that was favored by the association's founders, makes explicit what was common to all those new logical trends: the appeal to symbolism. Although early occurrences might be found, the expression "symbolic logic" seems to have been popularized by John Venn who used it in his writings to identify the logic that was developed after George Boole's mathematical theory of logic. Symbolic logic differed from traditional logic in its thorough and systematic use of symbolism. Several rival symbolisms were developed and logicians often provided spontaneous theories of sign to support the notations they designed. However, this practice raised several issues that were in dispute among logicians as to the signification and the manipulation of those symbols in logical calculus. The object of this paper is to address these early disputes as to what makes symbolic logic "symbolic".

Formal and transcendental logic

Kovac Srecko
Institute of Philosophy, Zagreb, CROATIA

While the term "formal logic" does not seem to have today an unambiguous, precisely defined meaning, the term "transcendental logic" is rarely used at all, except in a historical context. Despite of that, both terms, if traced back to their historical origins, show their modern relevance, although with certain limits. We, first, give an overview of the most common ways in which the term "formal logic" is encountered in contemporary literature, and relate it to the concepts of "formalized language" and "formal system". We then turn to the historical origins and delineate the concepts of formal and transcendental logic as they are conceived in I. Kant. We analyze the meaning of "logical form" within Kant's "functional" account of formal logic. A possible formalization of Kant's primitive concept of the formal unity of apperception, which lies at the foundations both of his formal and transcendental logic, reveals what should be for Kant a fundamental "structure" included in any logical form. Although Kant's formal logic seems to be restricted to a narrow area of some traditionally well-known logical forms, we show that it also comprises an outline of sort of paraconsistent and paracomplete logics. We then describe some limitations of Kant's conception of formal logic, which, unlike mathematics, remains unsusceptible to a "symbolic construction" of concepts. Finally, we show in which way Kant's transcendental logic can be described as a higher-order and model-theoretical framework comprising a first-order subtheory of empirical appearances. We claim that modern formal semantics and formal ontology are the main successors of Kant's transcendental logic. On the other side, despite of some essential connections, no logic seems to be today a strict successor of Kant's formal logic as a general logic of all our thought. Hence, formal logic in a strict sense remains to be only a "regulative idea", directing a most general logic research to its ideal endpoint.

What is pure in Husserl's idea of pure logic?

Isaac Manuel Gustavo
Paris Diderot University, FRANCE

Emerging in 1895 and set out in the last chapter of the *Prolegomena* (1900), Husserl's idea of pure logic is the cornerstone the *Logical Investigations* (1901). In that respect, the logicality of the six investigations can be viewed in the light of the purity of pure logic. But what is pure in it? what does *pure* mean in Husserl's idea? or, more precisely, what conception of logic does the epithet *pure* involve? Such questions bring first and foremost the demarcation of the field and the identification of the status of Husserl's idea into play. Once that field characterized by the rejection of any psychological or empirical ground and by the focusing on the ideal (a priori, analytic, formal) structure of scientific theories in general, once the status of pure logic defined as the nomological science determining the possibility of theoretical knowledge, what the understanding of the purity of pure logic puts at stake is the structuring of Husserl's idea. Husserl configures his pure logic mainly on two levels: an upper one dealing with the relation linking a system of axioms to its formal domain (the level of formal or 'mathematizing' logic); a lower one, grounding epistemologically the former by setting the categories and laws of its ontological and apophantic dimensions (the level of the pure theory of parts and wholes and of the pure morphology of significations). And when the linkage of those two levels is understood from the viewpoint of Husserl's semiotics *Logical Investigation*, I), what is finally highlighted is that the purity of Husserl's pure logic involves a conception of logic which attempts to get a conception of truth harmonizing a theory of (logical) knowledge and a theory of meaning (via the notion of *intentionality*). In that sense, *pure* means here nothing but a systemic and transcendental extension of formal logic.

On the minimality of minimal logic

Odintsov Sergei
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The system, which we know as minimal logic, is a paraconsistent version of intuitionistic logic by A.Heyting. It received his name after the work of Ingebrigt Johansson (1937). The situation with this logic is a little bit unhappy. On one hand, it was not considered by constructivists as a serious alternative to Heyting logic. On the other hand, specialists on paraconsistency like to emphasize that this logic is only formally paraconsistent due to its negation destructive character: all negated formulas are provable in every inconsistent theory over minimal logic. However, this logic has a very remarkable history. It was suggested for the first time by Andrey Kolmogorov (1925) as the first formalization of intuitionistic logic, the well-known Glivenko theorem was also proved for the first time not for intuitionistic logic, but for a system closely related to minimal logic. In this talk I will survey the details of the early history of minimal logic and discuss the question of its minimality. For Johansson, the choice of the name "minimal logic"' was justified by the fact that the negation of minimal logic can be presented as $A \to \perp$, where $\perp$ is a constant, about which nothing is postulated. However, Johansson itself anticipated a possible weakening of his system. He emphasized that the negation of a formula in his system should be treated rather as an "impossibility"' than a "falsity"' of this formula. Later Vakarelov and Dosen suggested systems, where the negation operator is interpreted as a modality of impossibility. It turns out that the minimal negation is a special kind of such operators. This and other weakenings of minimal negation presented in the literature and suggested by the author will be discussed in the talk.

SUPPOSITIONES AND CONSEQUENTIAE IN MEDIEVAL LOGIC: HISTORICAL AND PHILOSOPHICAL INQUIRIES

Wednesday, August 5 • 14:30–16:30
Main Building, Room 4

In the Middle Ages, especially in the XIV century, Logic (which includes Semantics and metaphysical issues) is a field extremely flourishing and that reaches a high degree of sophistication. Not only the traditional Aristotelian framework (Logica Vetus, Logica Nova) is deeply studied and meditated by medieval logicians and undergoes some interesting developments, but there are also some new and originally medieval contributions regrouped in the so called Logica Modernorum. Among these, suppositiones and consequentiae are particularly important and interesting, both historically and logically.

What counts as logic in the Middle Ages appears to be quite different from the way we conceive contemporary logic, for example both for the languages involved and the extension of the fields. Yet there are enough similarities to justify the philosophical and logical interest, beyond the antiquarian curiosity, of an historical work on some central notions, such as the notion of consequence. We can't engage with medieval logic without carrying with us our contemporary conceptual baggage, our contemporary questions. If we are aware of this and of the distance that separates and connects us modern logicians to our late medieval colleagues, and if we try to respect our medieval sources, "sitting in the middle", in that distance, could be enlightening for our work as historians and give us, as logicians and philosophers of logic, some new deep insight on the nature and the workings of Logic - on what logic is and could be.

Our symposium aims to give a contribution of this sort to the history and the philosophy of logic. We will focus on some aspects of supposition theory and consequentiae in late medieval logic; by doing so we will tackle some fundamental logical and semantic issues - such as the relation of consequence, propositional truth, the concept of formality and formal validity.

Collective Nouns and Plural Quantification in William of Ockham

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This paper is dedicated to the semantics of numerical terms according to Ockham and in particular to their distinctive property, namely that they are collective nouns. Indeed, the proposition in which they stand has peculiar truth-conditions. For instance, if the proposition 'these dogs are five' is true, it is impossible for the proposition 'this – an entity which is five being designated- is five' to be true. There is no such thing as an entity in the world that would explain that the dogs are five and not seven. A concrete natural number is nothing other than the things numbered. In this sense, plural reference is irreducible to singular reference, which is regulated by the truth-conditions given by Ockham in the first chapters of the second part of the Sum of Logic.

Ockham does not acknowledge the existence of a peculiar mode of personal supposition to explain collective reference. In the 1990ies, S. Read has argued that this kind of mode of personal supposition has not been acknowledged as such before about 1330, a long time after Ockham elaborated his semantics of numerical terms. Moreover, the emergence of this fourth mode of personal supposition is not related to a philosophical reflection on collective reference as such, but to questions pertaining to the completeness of the modes of personal supposition. That could explain why Ockham does not speak of collective supposition, and why he uses only the old Priscian grammatical notion of collective noun.

In this paper, we will try to answer more precisely the question why Ockham did not succeed in taking into account this special kind of reference in his supposition theory and we will examine whether his quasi-intuitive notion of plural reference can be compared to contemporary developments on plural quantification.

Two medieval traditions in the meaning of 'formally valid'

Yrjönsuuri Mikko
University of Jyväskylä, FINLAND

While modern logic relies on a relatively univocal concept of 'formal', many late medieval logicians point out that the claim that an inference is 'formal' (formalis) or 'formally valid' (valet formaliter) can be understood in two fundamentally different ways. (1) On the one hand, the concept is close to the twentieth century concept of 'analytic validity', and in this meaning it is often defined with reference to the idea that the consequent is included in the antecedent, or the understanding of the consequent is included in the antecedent. (2) On the other hand, validity was understood to be formal if and only it any inference achieved through any substitution of the material parts of the inference yields an equally valid inference. Neither of these definitions of 'formal' was understood to serve as a criterion of validity, since most authors accepted non-formally valid inferences. Furthermore, the second criterion was not taken as an explanation of grounding for validity even by its defenders. The paper discusses these two traditions of the concept 'formally valid' in the late thirteenth and fourteenth century contexts, paying attention to such authors as Walter Burley, Wiliam Ockham, John Buridan, and so-called Pseudo-Scotus. Paul of Venice is taken under closer scrutiny as an author who thought that the two definitions are incommensurate to the extent that it makes sense to evaluate inferences separately in relation to each definition. Thus, he specified the class of inferences that is 'formal' in both senses, the class that is 'formal' in the first sense but not the second, and the class that is valid but not 'formal' in either senses. As Paul shows, there are no inferences that are 'formal' in the second sense but not in the first.

Consequentiale and Expositiones in Marsilius of Inghen's Treatise on Consequences

Ciola Graziana
Scuola Normale Superiore, ITALY
UCLA, UNITED STATES

My talk will focus on Marsilius of Inghen's Consequentiae; I will proceed with an overview of the (still critically unedited) text and with an analysis of some relevant aspects of the theory.

Marsilius' treatise is divided in two sections: the first one is a theoretical exposition of his doctrine on consequences; the second part implements the set of rules given in the first section to treat specific groups of inferences, expositiones, from some sentence to another that can be derived from it.

For the first section, I will focus on Marsilius' definition of consequentia bona, and his accounts of formal and material consequences. In particular I will examine his stance on the consequentia ut nunc, that he apparently rejects - as already briefly noted by Bos (Bos 1976). By examining the set of accepted rules, I will outline the structure of Marsilius' theory of consequences.

For the second section, I will analyse some expositiones: in doing so, we will see in play the general rules given in the first part and how that set is extended to account for the examined cases. In doing so I will tackle the problematic (Spade 2000) issues of exponibiles and expositio propositionum in Marsiliu's case, by means of the his theory of consequence and of supposition.

By giving a more detailed, grounded, and systematic analysis of Marsilius' Consequentiae, on the one hand, I aim to contribute to give a more precise and detailed picture of the articulation of the complex XIV century debates around consequences; and, on the other hand, to shed some light on the related matter of expositions.

THE FOUNDATIONAL SIGNIFICANCE OF ABSTRACT MODEL THEORY

Thursday, August 6 • 11:00–13:00
Main Building, Room 12

General description: There is a problematic discrepancy between the current state of logic and mathematics and much philosophical thinking about the foundation of mathematics. The study of logic beyond the confines of the first order realm has been going in earnest since at least the late 1950s, such as with Mostowski's work on generalised quantifiers. It has resulted in the growth of abstract model theory in general and the theory of institutions in particular. This development marked a decisive shift away from a focus upon the isolated investigation of specific (especially first order) logical systems to one upon the relationships between a wide range of logics. Early abstract model theory assigned ascribed a central place to the notion of an abstract logic (with major results being Lindström's 1969 theorem [1] and Barwise's 1974 axiomatisation [2]) and made some use of categorial ideas. The theory of institutions was introduced by computer scientists Goguen and Burstall [3] to relate logics, such as fragments of many sorted first order logic and higher order logic with polymorphic types. The concept of an institution is more general than that of an abstract logic since it is a fully categorical abstraction of the main logical concepts of signature, sentence, model, and of the satisfaction relation between them [4]. Recently the theory of institutions has been utilised for model theoretic constructions where concrete structures (like that of the field of real numbers) are absent and to a form a major part of the increasingly influential Universal Logic program [5].

Despite the rising importance of abstract model theory in its various forms a good deal of philosophical work on the foundations of mathematics, such as neo-logicism, takes first order logic to be the paradigmatic form of logic and one which provides the greatest explanatory clarity. Consequently, such philosophical analysis explains logic and its relationship to mathematics as it used to be and not how it currently is. Over the course of the 20th century algebraic and geometric ideas have become central to mathematics so philosophical foundational work on the relationship between logic and mathematics must take account of this significance. Contemporary model theory very largely works with algebraic and geometric concepts and in doing so it has moved away from a set theoretical focus towards one upon questions of definability. Abstract model theory especially in its institutional form enables further definition and classification of these types of structures and thus contributes to a category theory approach to the foundations of mathematics.

[1] P. Lindström, On Extensions of Elementary Logic, Theoria 35, pp.1-11, 1969. [2] J. Barwise, Axioms for Abstract Model Theory, Annals of Mathematical Logic 7, pp. 221–265, 1974. [3] J. Goguen and R. Burstall, Introducing Institutions, (E. Clarke, D. Kozen eds), Proceedings Logics of Programming Workshop, volume 164 of Lecture Notes in Computer Science, pp. 221-256, Springer, 1984. [4] R. Diaconescu, Three Decades of Institutions, (Jean-Yves Beziau ed.), Universal Logic: an Anthology, pp. 309-322, Springer Basel, 2012. [5] UNILOG: http://www.uni-log.org/

On the Theory of Institutions and The Philosophical Significance of Categorical Thinking

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The theory of institutions is an advanced form of abstract model theory which reflects categorical thinking about model theory. Independence from actual logical systems has been achieved by institutions theory through a full categorical abstraction of the main logical concepts of signature, sentence, model, and the satisfaction relation between them. Category based mathematical theories do not give any importance to the internal structure of particular objects (here logical systems) instead they think of the objects in terms of their relationships to all other objects given by homomorphisms. This approach is radically different from the customary set-theoretic approach of abstract model theory, and it has far-reaching philosophical consequences not only regarding the study of logic and mathematics, but also the traditional Western way of thinking in general. Joseph Goguen and Rod Burstall, who introduced the theory of institutions in the 1980s [1], were also

well aware of this fact. Drawing from their work, as well as from the work of psychologists Richard Nisbett [2] and Carl Jung [3], the philosophical significance of a categorical approach to the study of logic is explored, claiming that it reflects a shift towards the traditional Eastern way of thinking, as exemplified by the philosophy of Buddhism [4]. Finally, it is argued that this development goes hand in hand with the increasing tendency of incorporating Eastern elements in Western thought.

[1] R. Burstall and J. Goguen. Introducing Institutions, (E. Clarke, D. Kozen eds), Proceedings, Logics of Programming Workshop, volume 164 of Lecture Notes in Computer Science, pp. 221-256, Springer, 1984. [2] R.E. Nisbett. The Geography of Thought, Free Press, 2003. [3] C.G. Jung. Jung on the East, (J.J. Clarke ed.), Routledge, 1995. [4] R. Diaconescu. Institutions, Madhyamaka, and Universal Model Theory, (Jean-Yves Beziau and Alexandre Costa-Leite eds.), Perspectives on Universal Logic, pp. 41-65, Polimetrica, 2007.

Categorical Representation of Discrete Dynamical Systems Computability

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In discrete dynamical systems computability is characterised by a state space of hereditarily finite sets combined with operations on those sets [1]. A class of states and operations transforms a given state into a succeeding one, and isomorphism and invariance relations between states define structural classes [2]. Such systems can be regarded as a generalisation of Gandy machines [3] thus enabling representation of computable processes which extend beyond Turing machines. Evolutionary computation is an important type of computable process which uses probabilistic operators with the evolutionary range being abstractly conceptualised as the space of all possible evolvable programs. Discrete dynamical systems are utilised in a novel way to represent the properties of evolutionary computation as a class of discrete dynamical system computable processes. The representation provides a clear and comprehensive computational characterisation of the evolutionary process. Since the representation is complex the logical and philosophical gains achieved from simplifying it through the use of the abstract model theory approach of the theory of institutions [4] are considered. This work contributes to the development of a category theory approach to the foundations of computability theory.

[1] Sieg, W. [2008]. Church without dogma: axioms for computability. In New Computational Paradigms (Cooper, B., Löwe, B. and Sorbi, A. eds.). New York: Springer, 139-152. [2] Sieg, W. [2003]. Calculations by man and machine: mathematical presentation. In the Scope of Logic, Methodology and Philosophy of Science. (Gärdenfors, P., Wolenski, J. and Kijania-Placek, K. eds.). (Synthese Library volume 315.) Dordrecht: Kluwer, 247-262. [3] Gandy, R. [1980]. Church's Thesis and principles for mechanisms. In The Kleene Symposium (Barwise, J., Keisler, H. and Kunen, K. eds.). Amsterdam: North-Holland, 123–148. [4] Diaconescu R. [2012]. Three Decades of Institutions, (Jean-Yves Beziau ed.), Universal Logic: an Anthology, pp. 309-322, Springer Basel.

SYMPOSIA

Syntactic Generic Constructions and their Applications

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The notion of syntactic generic class [1] generalizing semantic one [2] is defined and a survey of results confirming the significance of syntactic approach for the classification of countable models of complete theories in general and for the class of stable theories, realizing basic characteristics with respect to Rudin-Keisler preorders and distribution functions of limit and other countable models of a theory [3-5] is presented. Another application deals with algebras of distributions for binary formulas of a theory with respect to compositions of formulas. Generic constructions allow proof of axiomatizations of the class of these algebras and of their refinements by natural lists of properties [6-8]. Tools for investigating links between generic classes as well as topological properties for classes of structures related [9] are discussed.

[1] S.V. Sudoplatov, Syntactic approach to constructions of generic models, Algebra and Logic, vol. 46 (2007), no. 2, pp. 134-146. [2] J.T. Baldwin, N. Shi, Stable generic structures, Annals of Pure and Applied Logic, vol. 79 (1996), no. 1, pp. 1-35. [3] S.V. Sudoplatov, The Lachlan problem, Novosibirsk, Edition of NSTU, 2009. [4] R.A. Popkov, S.V. Sudoplatov, Distributions of countable models of complete theories with continuum many types, arXiv:1210.4043v1 [math.LO]. [5] S.V. Sudoplatov, Classification of countable models of complete theories, Novosibirsk, Edition of NSTU, 2014. [6] S.V. Sudoplatov, Algebras of distributions of formulas with respect to generalized semi-isolation}, Algebra and Model Theory 9, Novosibirsk: Edition of NSTU, 2013, pp. 67-100. [7] I.V. Shulepov, S.V. Sudoplatov, Algebras of distributions for isolating formulas of a complete theory, Siberian Electronic Mathematical Reports, vol. 11 (2014), pp. 380-407. [8] S.V. Sudoplatov, Algebras of distributions for semi-isolating formulas of a complete theory, Siberian Electronic Mathematical Reports, vol. 11 (2014), pp. 408-433. [9] S.V. Sudoplatov, Classes of structures and their generic limits, Lobachevskii Journal of Mathematics. (to appear)

MUST EVERY THING GO?

Thursday, August 6 • 17:00–19:00
Main Building, Room 10

In their thought-provoking 2007 book Every Thing Must Go, Ladyman and Ross advocate ontic structural realism (OSR), a view according to which relational structures are primary to things. They argue that OSR is motivated by current fundamental physics, thus implying that a true naturalist has compelling reasons to adopt it. In this symposium the aim is to reflect and critically examine a number of issues connected to OSR. Are there valid alternatives to taking relational structures alone as fundamental? To what extent might OSR, after all, be underdetermined by contemporary physics? Can objects be truly eliminated from fundamental physics, and might there be a new notion of fundamentality which has room in it for both relational structures and objects? Finally, might an ontological interpretation of quantum theory provide a new way of understanding the dynamic relation between structures of information and quantum particles? The symposium consists of four intertwined papers which address these and similar questions. While the papers are critical of eliminativist and extreme versions of OSR, the symposium also attempts to take up the structuralist challenge and find a proper place for structural relations in naturalistic metaphysics. There will be four talks of 20-25 minutes each, with a short question period after each talk and a general discussion at the end.

Every thing must stay

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Atomism is the idea that the fundamentals of the universe are indivisible “atoms” or particles. Atomism is at least at first blush a contrary of the idea that what is fundamental are relations, or more ambitiously still, structures or full patterns of relations. I will refer to the latter idea as Ontological Structuralism, or simply Structuralism. Of course there is a third view which says that the two initial views are not contraries at all, and that both atoms and structures are fundamental, comprising separate and irreducible realities, neither beholden to the other.

Another view, the one I shall adopt here, is that in reality atoms are ontological placeholders for nodes in a larger reality that I will refer to as a mosaic. The mosaic, as I will argue, is what equations (in Physics, for example) seek to articulate at least in part. So the mosaic also speaks of patterns. Thus the mosaic is neutral as between atomism and structuralism, naming neither category (object or relation) as more fundamental. This leaves us with the question of what to do with the question of fundamentality. Shall we adopt atomism as against structuralism, or the reverse? Is it a good idea to think of them as competitors? Indeed, can we view physics as having anything whatever to say on the subject of fundamentality?

I shall argue that in fact (the complete sets of) atoms and structures are duals—neither more fundamental than the other, and in full complement interchangeable. The duality does not make its appearance unless one can view a large enough piece of the mosaic. I will illustrate this duality view by examples to do with the (purportedly contrasting) behaviors of fermions and bosons, which have parallels in studies of dynamics (of synchrony). The examples enjoy simple analogies in mathematics.

Some skeptical remarks about ontic structuralism

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The original intuition behind ontic structural realism was that it fills a gap between epistemology (‘we can only know structure’) and metaphysics by claiming that structure is all there is. To substantiate the latter metaphysical claim, it was initially suggested that structuralism sidesteps a problematic underdetermination arising when one attempts to interpret quantum mechanics in terms of objects. However, as I will briefly contend, this argument is not compelling. While some authors (in particular Steven French - see, for instance, French (2014)) stick to it nevertheless, others have more recently tried to lend support to structuralism by showing that contemporary science, physics in particular, tells us that relations are fundamental. This is no doubt the basic idea underpinning Ladyman and Ross' Every Thing Must Go (2007). I will argue that this strategy too is unsatisfactory as it stands.

First, all the specific physical scenarios putatively indicating the fundamental structural/contextual nature of things turn out, upon scrutiny, to again leave the metaphysics entirely underdetermined. Secondly, even if one grants the 'structural reducibility' of intrinsic properties and/or identities, the structuralist slogan needs to be turned into a precise ontological picture. Besides revealing that much more metaphysics of the traditional kind is required than Ladyman and Ross may have hoped, this turns out to be a difficult task. To begin with, a serious confusion between abstract and concrete structures lurks. Moreover, can relations be self-subsistent, or do they need relata? In the latter case, can the simple claim that it is 'relations all the way down' (Ladyman and Ross 2007; 152-155) solve the problem? I will explore some possible answers to these questions, and point out potential problems for the structuralist project that each one of these answers brings with itself. The upshot will be that structuralists like Ladyman and Ross need to do a lot more work to make a truly compelling case for their preferred metaphysics. In particular, the idea that structuralism 'directly flows' from our best science should be abandoned, and determining whether or not structuralism is at least the most plausible metaphysical interpretation of (a part of) science requires a complex evaluation of empirical data as well as of theoretical virtues. (Among the latter, incidentally, conservativeness of established beliefs cannot simply be dropped based on the idea that 'science has progressed through a series of conceptual revolutions and taught us that common sense is often wrong'!).

Structuralism and fundamentality

Tahko Tuomas
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It is a central claim of ontic structural realism (OSR) that reality is fundamentally relational or structural. One radical upshot of this claim is taken to be that there is only structure or, in other words, that there are no things or objects. This flies in the face of mereological atomism – the view that what is fundamental are indivisible 'atoms', fundamental particles. Indeed, OSR could be considered a nail in the coffin of this typical view about fundamentality. Hence, OSR suggests that we must understand the fundamental quite differently.

An interesting attempt to explicate the sense of fundamentality associated with OSR has been made by McKenzie (2014). McKenzie concludes that 'any "eliminative" structuralism in which objects are purged from the fundamental basis is [...] untenable as a general thesis about physics, since one cannot eliminate the objects without thereby eliminating the structures' (p. 377). However, the resulting picture of the fundamental is, according to her, still different from that of purely object-oriented metaphysics, such as mereological atomism. The question that emerges is the following: Do we need two different (sub-)species of fundamentality to understand the different approaches of object-oriented and structuralist metaphysics or can they be reconciled? The hypothesis of this paper is that a single, more generic understanding of fundamentality can accommodate both pictures of the fundamental: a reconciliation is possible. A sketch of how this is to be done will be provided, by resorting to the notion of ontological minimality. The core idea is that fundamentality is a general thesis about ontologically minimal elements, where 'ontologically minimal elements' can be structures, relations, objects, or whatever.

Dynamical information structures in quantum theory?

Pylkkänen Paavo
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As a part of their defence of ontic structural realism (OSR), Ladyman and Ross (LR) appeal to non-relativistic quantum theory (QT), more precisely to the idea that according to the usual interpretation of QT, two or more particles in an entangled state are at most weakly discernible. This LR take to imply a thoroughly structuralist ontology of quantum individuals, as the implication is that "individuals are nothing over and above the nexus of relations in which they stand". However, as LR acknowledge, there is an interpretation of QT which gives individuals a much stronger status, namely the Bohm theory (BT). In BT an electron, say, is a particle always accompanied by a new type of quantum field guiding it. Because the particle is assumed to have a well- defined position and momentum at all times, the BT provides a counterexample to the anti-individualistic interpretations of QT and thus challenges part of the justification of OSR. However, there is a sense in which structure becomes important in Bohm and Hiley's later developments of BT (1987). For when examining in more detail just how the quantum field affects the particle, they were led to propose that the field carries active information (e.g. about the structure of the environment, such as the presence of slits) which literally in-forms (or puts form into) the movement of the particle. This suggests that information (in the sense of form or structure) is a significant causal factor in the quantum domain. This can be generalized into an ontology where structures of information, individual particles and fields are in dynamical interaction. While structures of holistic information are fundamental in this ontology, particles retain a relatively autonomous existence at the quantum level. This quantum ontology effectively becomes the classical ontology of everyday objects whenever the effect of quantum information is negligible. Thus, every real thing can stay and enjoy a relatively autonomous existence in the ontology of BT. Underlying and enabling this relative autonomy is, however, the dynamic level of structures of information.

References: Bohm, D. and Hiley, B. J. 1987. An Ontological Basis for Quantum Theory: I. Non-relativistic Particle Systems. Physics Reports 144 (6): 323-348. French, S. 2014. The Structure of the World: Metaphysics and Representation. Oxford: Oxford University Press Ladyman, J. and Ross, D. (with Spurrett,. D. and Collier, J.) 2007. Every Thing Must Go. Metaphysics Naturalized. Oxford: Oxford University Press. McKenzie, K. 2014. Priority and Particle Physics: Ontic Structural Realism as a Fundamentality Thesis. British Journal for the Philosophy of Science 65: 353–380. Ross, D., Ladyman, J. and Kincaid, H. eds. 2013. Scientific Metaphysics. Oxford: Oxford University Press.

SOCIAL MISTAKES

Thursday, August 6 • 17:00–19:00
Main Building, Room 14

Introduction:
Proietti Carlo
Philosophy, Lund University, Lund, SWEDEN

Introduction (by Proietti)

Everyday life provides many examples of situations where individuals being subject to social influence and peer pressure behave quite differently from how they would do in isolation. Very often influence and peer pressure lead to subobtimal decisions where individuals are all caught in a “collective mistake”. The bystander effect (Latané and Darley 1969) is a typical case in point: people in large groups often fail to act on behalf of the victim of an accident because looking at others who don’t act. By doing so they are lead to underestimate the gravity of the situation. Other popular cases of “irrational” collective dynamics are pluralistic ignorance (Miller 1987), informational cascades (Bikhchandani et al. 1992), group polarization (Moscovici and Zavalloni 1969), eco-chambers, false consensus effects as well as many others.

Most of these phenomena were brought to attention and studied by social psychologists. For some of them behavioural economics and social network theory provides insightful formal analyses, explanatory models and simulations (e.g. see Centola et al. 2005). Although these phenomena represent interesting puzzles for collective rationality, most of them got only recent attention in formal epistemology (see e.g. Hendricks 2014 and Proietti and Zenker 2014). However, formal epistemology has a significant potential in explaining and analysing these dynamics, for the specific reason that they involve first order and higher order/nested beliefs and credences (e.g. “I believe that others believe”) for which epistemic logics and bayesian epistemology provide useful formal tools that other formal approaches do not provide.

The general aim of this workshop is to present some of these dynamics, to explain their relevance for epistemology and the recent work of the authors in this area. Particular attention will be given to introducing the rich set of formal tools that help a better categorizing and comprehension of the key concepts involved. Indeed, these dynamics are usually very complex ones and many ingredient factors contribute to their emergence, e.g. belief, trust, social pressure, social proof etc. Both dynamic epistemic logics and Bayesian probabilistic methods are employed by the authors to analyse, explain and unravel these notions and thereby framing a fruitful formal analysis of the dynamics at stake.

Bikhchandani, S., Hirshleifer, D., and Welch, I. (1992), “A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades,” Journal of Political Economy, Volume 100, Issue 5, pp. pp. 992-1026. D. Centola, M. Macy, R. Willer. The Emperor’s dilemma. A computational model of self-enforcing norms, American Journal of Sociology, (110) 1009-1040, 2005. P.Hansen, V. Hendricks. Infostorms, Springer 2014. B. Latané, J.Darley. Bystander intervention in emergencies. Diffusion of responsibility. Journal of Personality and Social Psychology vol. 8 377-383. D. T. Miller, Pluralistic ignorance: When similarity is interpreted as dissimilarity in Journal of Personality and Social Psychology, vol. 53, p.298, 1987. Moscovici, S.; M. Zavalloni (1969). “The group as a polarizer of attitudes”. Journal of Personality and Social Psychology 12 (2): 125–135. Social dynamics and collective rationality, C. Proietti and F. Zenker eds., Synthese vol.191 (11), 2014.

Virtuous and vicious consensus

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In this paper, we distinguish between two hypotheses that could account for consensus on a question or a set of questions. The first hypothesis is that the members of the group are reliable truth-trackers, and that they for this reason have ended up with the same true beliefs. The second hypothesis, on the other hand, is that the consensus is rather due to one of various non-rational belief forming processes such as peer pressure, dogmatism, group think and other forms of biases, etc.

Whilst social epistemologists and other researchers have done a lot of work explaining how consensus might result from rational (e.g. C.I. Lewis 1946) and non-rational processes (e.g. Sunstein 2006) less work has been done on the question of how to distinguish between these two hypotheses. Here some issues pertaining to that question are addressed. We first address consensus on a single proposition. In such a case, a high degree of consensus in a group is likely to be vicious (i.e. caused by non-rational processes) – as opposed to virtuous (i.e. caused by rational processes) – if a) the proposition is controversial, b) the group is not more competent than other groups, and c) we know of one or more mechanisms that would give rise to vicious coherence that the group has in common. This is shown to be true by a simple mathematical model.

Next, we address consensus on multiple propositions – i.e. where a group converges not only on one but on a number of different issues. We show that if these issues are probabilistically independent of each other, such consensus is even more likely to be vicious, given a)-c). Finally, we tentatively discuss how this analysis of virtuous and vicious consensus could be extended to other, more complicated, scenarios.

References: Lewis, C. I. (1946). An Analysis of Knowledge and Valuation. La Salle, Illinois: Open Court. Sunstein, Cass (2006). Infotopia : how many minds produce knowledge. Oxford: Oxford University Press.

Reflecting on social influence and pluralistic ignorance

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Pluralistic ignorance is a prime example of how social influence might lead to social mistakes. Loosely put, pluralistic ignorance is a situation where a group of individuals all have the same private opinion, while at the same time, they all show behaviors contradicting their private opinion. This type of social mistake is interesting for several reasons, particularly; it is both fragile and robust. Pluralistic ignorance is robust in the sense that if the context stays unchanged, the phenomenon will persist. It is fragile in the sense that if one agent reveals her private opinion, everyone may start behaving in accordance with their private opinion. Christoff and Hansen (2013) developed a formal logical model of social influence, based on previous work by Liu, Seligman, and Girard (2014), capturing exactly the fragility and robustness of pluralistic ignorance and relating them to the underlying social network representing the structure of social interaction.

However, there is one clear deficit of the model proposed by Christoff and Hansen, namely, it is assumed that agents do not reflect on how they, and their peers, are affected by such influence. We will make up for this deficiency by allowing agents to reflect on other agents' behavior and thereby potentially learn about others private opinions. Of course, this expanded model makes the notion of social influence more complex. Moreover, it raises the question of whether the fragility and robustness of pluralistic ignorance are affected.

Christoff, Z and Hansen, J. U, (2013), "A two-tiered formalization of social influence", Logic, Rationality and Interaction, Proceedings of the Fourth International Workshop (LORI 2013). Lecture Notes in Computer Science 8196(2013): 68-81, Springer, 2013. Liu F, Seligman, J, and Girard, P, (2014), "Logical dynamics of belief change in the community", Synthese 191(11): 2403-2431, Springer, 2014.

Cascades: Macro and Micro Perspectives

Rendsvig Rasmus
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In life, we take cues from others. We learn skills through imitation and we draw abductive conclusions from interpreted actions. Learning by imitation and social proof is a strong mechanism, so strong in fact that not only individuals, but also groups and populations may be subject to it's consequences. As the common lemming metaphor points out, taking cues from others may not always provide safe conduct.

In this talk, we will introduce and discuss the notion of cascades, framing such as informational domino effects in populations. The notion will be introduced and it's importance illustrated by empirical examples, typically with comical consequences.

Following, we will present macro and micro perspectives on cascades in populations. The macro perspective is essential as it is at this level cascades are manifest. As the macro level dynamics arise due to information processing at the micro level, individuals' belief revision strategies play a key role. Both perspectives have received treatments in various fields such as formal philosophy, social psychology and economics. It is the goal of this talk to present the common denominators from these treatments and show how they jointly explain why well-connected, information processing humans may collectively come to jump off the same cliff that lemmings are stupid enough to stop short of.

This paper is based on joint work with Vincent F. Hendricks, University of Copenhagen.

TRACKING THE DIAGRAMMATIC TURN IN RECENT PHILOSOPHY OF NOTATION

Thursday, August 6 • 17:00–19:00
Main Building, Room 8

Champagne Marc
Philosophy, History, Culture and Art Studies, University of Helsinki, Helsinki, FINLAND
Bellucci Francesco
Philosophy and Communications, University of Bologna, Bologna, ITALY
Burton James
Computing, Engineering and Mathematics, University of Brighton, Brighton, UNITED KINGDOM
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Arts and Cultural Studies, University of Copenhagen, Copenhagen, DENMARK
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Symbols represent by codes like conventions, whereas icons represent by similarity (Couturat 1901; Dascal 1978; Gensini 1991; Serfati 2001). Until recently, much of the literature in philosophy of notation tended to follow Leibniz in assuming that we always or most often think in symbols. However, current debates have increasingly been driven by the recognition that any system of representation depends, to some extent, on iconicity, such that the purported line of demarcation is rather a continuum (Stjernfelt 2014). This slow but resolute turn toward iconic signs has begun to change how we see logic. With different emphases, linguists (Simone 1995; Van Langendonck 2007), logicians (Burch 1991; Shin 1994, 2002; Hammer 1995; Allein & Barwise 1996; Pietarinen 2006, 2010, 2011, 2012), historians of mathematics (Nets 2004; Mancosu, Jorgensen & Pedersen 2005; Giaquinto 2007), semioticians (Stjernfelt 2007, 2014; Bordron 2011; Dondero & Fontanille 2012), philosophers of mind (Champagne 2014) and cognitive scientists (Glasgow, Nara y Anan & Chandrasekaran 1995; Hoffmann 2010a, 2010b, 2011; Magnani 2011; Nakatsu 2010) have all recognized that a better understanding of reasoning by icons, specifically diagrams, is crucial to understanding problem-solving, inference-drawing, and hypothesis-making.

Arguably, no one has explored the potential of iconic notations more systematically than C. S. Peirce. It is commonly believed that the birth of new formal logic(s) by Frege (1884), Russell (1903) and Couturat (1904) rendered Kant's appeal to intuition redundant (cf. Kneale & Kneale 1962, VII-VIII; Coffa 1991; Carson & Huber 2006). However, an alternate line of development is clearly discernable in the work of Peirce. For Peirce, the notion of intuition is by no means redundant, being instead the faculty which allows necessary reasoning to yield informative truths (Peirce 1931-1958; Peirce 2010; cf. Hintikka 1980; Hookway 1985; Ketner 1985; Shin 1997; Pietarinen 2006; Stjernfelt 2007; Bellucci 2012). The diagram, in this Peircean paradigm, transforms intuition into a visual commodity amenable to careful public scrutiny. Indeed, one of the most striking features of Peirce's diagrammatic notation is its depiction of inferences as transformations. Inference rules, being answerable to the self-same nature of images, are motivated in a way that makes them less rule-like. For example, enclosures, a common device used by Peirce, place distinct limits on what counts as included/inside, excluded/outside, or both. One can attempt to transgress these limits, but the iconic sign-vehicles at hand simply repel erroneous interpretations. While Venn exploited this to prove categorical syllogisms, Peirce shows how to generalize the method, thereby giving a novel justification for the normative force of logic.

Peirce's unpublished technical work in logic has thus far influenced debates mainly through the intermediary of specialists (Shin 2002; Sowa 2011), but the upcoming publication of Peirce's full Existential Graphs (Logic of the Future, edited by A.-V. Pietarinen) promises to augment this rate of influence, by making available a 1000- page buffet of diagrammatic and iconic logical systems. Participants to this symposium are thus invited to reflect on how Peirce-inspired diagrammatic approaches to notation can positively reshape issues pertaining to logic, cognition, and reason-giving practices generally.

Philosophy of Notation in Logic of the Future

Peirce's graphical systems of logic, especially his method of Existential Graphs, still harbour a number of mysteries, including, in the first place, their invention, development and the precise form and meaning. Peirce's 5000-odd pages of writings on Existential Graphs have, until now, largely remained unpublished. Roberts (1973) stands as the lone unfailing guide to Peirce's numerous logical systems and to his diagrammatic thought. And even when something relevant has been published, the presentation of Peirce's arguments that crucially depend on getting the diagrammatic notations exactly right were either cut short by altogether omitting those sequences that deal with the graphs, or else those presentations managed to distort Peirce's original intentions in overlooking the subtle logical, notational, typographical, chromatic and other design features involved in them. But it is precisely such features that we find him attenuating to when he was scribing the graphs and when he was designing what at first sight might look like new logical symbols and meaning by conventions of interpretation, although in reality they he meant these notations to serve, at least predominantly, the role of logical icons and meaning by resemblance. Peirce's reason for his insistence on such delicate notational features of icons was not only to maximize visual accuracy, readability, cognitive economy or pedagogical virtue of the resulting systems. The deeper reason was to develop new methods for logical analysis that would be superior to other methods.

Notation indeed contributes to analyticity. In this talk, I present some selected examples from the book that are representative of these deeper aims and what at the same time concern some decisive issues that have to do with getting the diagrammatic notations exactly right whenever reproducing, interpreting and improving upon Peirce's philosophical and logical thought.

Convention and Resemblance in Diagrammatic Proofs

Since he stated that diagrams should be "as iconic as possible," it seems fair to assume that Peirce favoured resemblance as a notational mode which is more effective, in some sense, than convention. However, his own logical diagrams frequently rely on features which are predominately symbolic. On the other hand, Euler diagrams could reasonably be said to be "as iconic as possible," but their iconicity is a double-edged sword – as well as providing the expressive appeal of "well-matchedness," the iconic nature of Euler diagrams can be implicated in problems of overspecificity and clutter. Existential graphs are capable of providing a more compact representation, relative to Euler diagrams, and do so by exploiting symbolic features. Furthermore, when the meaning of symbolic features is internalised by a user, their position on the spectrum from symbol to icon becomes less clear. The syntactic feature of a closed curve corresponds to its meaning in an Euler diagram (where it denotes a set) but not to its meaning in the system of existential graphs (where it denotes negation). However, it may be that a curve can acquire a resemblance to the concept of negation for experienced readers. Arguing for the benefit of using symbols when reasoning with visual logics may seem to overlook the distinctively graphical potential of diagrams. However, it would be too hasty to presume that the benefit of using diagrams for reasoning stems only from their differences from sentential logics. In this work, we explore the interdependence of the iconic and symbolic modes in the acts of making and reading diagrammatic proofs. We do this by examining the balance of convention and resemblance in individual inference rules and in entire proofs made using Euler-based and Peircean notations. We will also put this comparison in context by describing ongoing work to develop criteria for "readability" in automatically generated diagrammatic proofs.

Towards a Methodeutic of Necessary Reasoning

In 1902 Peirce announced his "first real discovery" in the philosophy of mathematical reasoning: the distinction between corollarial and theorematic deductions (Hintikka 1980). But what steps did Peirce take to arrive to such a distinction? Is this a critical or methodeutical distinction? As his works on formal logic proceeded, the notion of logical analysis became more and more central. Logical analysis is the first step of deduction; demonstration, either theorematic or corollarial, becomes the second. What distinguishes theorematic from corollarial reasoning is the presence in the former of a theoric step which is retroductive. Now, since it is retroductive, it is no wonder that it is in need of a methodeutic. That is why in his later years Peirce imagines an inventory of theoric steps in the history of mathematics. This inventory was part of what Peirce called a "methodeutic of necessary reasoning" (CP 4.613, 1908). But the methodeutic of necessary reasoning is not limited to the study and classification of theoric steps. Another fundamental part of the methodeutic of deductive logic is the study and invention of logical notations, which will also benefit from an historical survey of the "useful systems of logical representation" (MS 283). Here we have a fundamental distinction: deduction is not only a sign formaliter (the premise is a sign of the conclusion), but also a sign materialiter (as expressed in external signs). This contrast is captured by the distinction between operative and optimal iconicity (Stjernfelt 2014). The two parallel historical inventories of the "facts of deduction" belong respectively to two different senses of iconicity of formal thought: the inventory of theoric steps belongs to the operative iconicity (deduction as sign formaliter); the inventory of logical notations belongs to the optimal iconicity (deduction as sign materialiter). Both belong to the methodeutic of necessary reasoning.

The Origin of the Notion of Iconicity

"Iconicity" has become a widespread term in many areas of research during the recent decades, from logic to art history to computer interface studies. It may therefore be of interest to trace the origin of the term. It is widely believed that the term iconicity originates with Charles Morris' interpretation of C. S. Peirce's icon-index-symbol trichotomy, leading Morris to address degrees of iconicity. This popular gloss, however, is not correct. The origins of iconicity as a robust concept arose from Peirce's discussion of the optimal way of diagramming mathematical and, especially, logical structure. Moreover, already in Peirce, the notion addressed degrees of iconicity as a measure stick of the appropriateness of a representation. I thus propose to investigate the origin of such iconicity in Peirce in both its "operational" and "optimal" variants in order to show how the arguments for degrees of iconicity apply to the latter variant.

PRAGMATI(CI)ST PHILOSOPHY OF SCIENCE, OLD AND NEW

Friday, August 7 • 11:00–13:00
Main Building, Auditorium II

Ambrosio Chiara
Science and Technology Studies, University College London, London, UNITED KINGDOM
Pietarinen Ahti-Veikko
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Recent years have seen a revival of the Pragmatist tradition in philosophy of science. This panel aims at exploring the contribution of one of the most forceful voices in this tradition, who turns out to be also its founding father: Charles S. Peirce. It is well known that Peirce's contributions to philosophy, logic and methodology are to be interpreted as inseparable from his practice as a scientist. This panel explores four central areas of Peirce's philosophy, all reflecting key aspects of his distinctive pragmatist account of science: his work on abduction, his methodeutics and ethics, and his works in the history and historiography of science. Abduction forms one of the centrepieces of Peirce's approach to logic. It also constitutes the fundamental link between logic and Pragmatism more broadly. Peirce himself stated that, if considered carefully, his formulation of Pragmatism "is nothing else than the question of abduction" (EP2, 234). Our panel addresses the question of abduction from the particular viewpoint of Peirce's contribution to ill-posed inverse problems – that is, problems which arise in severely under-structured contexts. One of the tasks of abduction is indeed to cast light on how scientific inquiry deals with "unknown unknowns", and Peirce's interrogative construal of abduction offers a broader logical mode of investigation, especially suited for situations in which strict cause-effect relationships may be unobtainable. Peirce often referred to logic as complementary to methodeutic, which he defined as "logic in the broadest sense". Our panel addresses an aspect of Peirce's methodeutic which is particularly central to scientific practice: his account of the Economy of Research. Along with the contemporary significance of Peirce's account, we explore how the Economy of Research as a regulative ideal relates to scientific discovery, and to Peirce's maxim not to block the way of inquiry more broadly. Peirce's philosophy offers powerful conceptual tools to address issues in ethics, as well as logical and methodological ones. We present its relevance with reference to the specific question of ethical empiricism. Peirce's pragmatism, along with his account of emotional interpretants, seems particularly compatible with current philosophical positions relating emotions and perception. Specifically, we argue that it may be possible to draw on Peirce's ideas in developing a productive analogy between the possibility of revising our ethical views in light of (collateral) emotions, and revising (non-normative) theories in light of (collateral) observation. We conclude our contributions by placing logic, ethics and methodeutic in the broader context of Peirce's understanding of inquiry in its historical development. Peirce's work as a historian of science is often neglected even by Peirce scholars, and yet it forms an indispensable connection between his philosophy and his practice as a scientist. We use Peirce's formulation of the First Rule of Reason as a prime example of a methodological, logical and ethical maxim that emerged precisely from the context of Peirce's historical investigations, and show that in doing so Peirce advocated a view of history and philosophy as inherently complementary modes of inquiry into the nature of science.

Interrogative Abduction in Ill-Posed Inverse Problems

According to Peirce, abduction is a Modus Tollens from the premises "If A is true, C is not true" and "But C is not true", where the conclusion is an interrogative, "Is A not true?". He described the process as "Reasoning from Surprise to Inquiry", where the mood of the conclusion is a mixture of interrogative and imperative moods: "It is to be inquired whether A is not true" (MS L 463, 1905). Peirce termed this the "investigand" mood. Niiniluoto ("Abduction, tomography, and other inverse problems", 2011) observed that the branch of applied mathematics that studies inverse problems deals successfully with abductive types of inference. Niiniluoto takes abduction to be reasoning from effects to causes. This is a limiting view of abduction and may reduce some (e.g., well-posed, continuous, parametric-model) inverse problems as to be matters of deductive inferences.

Peirce's interrogative construal suggests a broad view of abduction fitted for situations in which strict cause– effect relationships may be unobtainable. Those situations concern severely under-structured problem contexts. In the area of inverse problems, such contexts give rise to ill-posed problems, where the converse of a continuous mapping is discontinuous, so that analog samples do not work, models are non-parametric, etc. Inference in such contexts calls for abduction in its interrogative or investigand mood of 'guessing at the unknown unknowns', for example when forming confidence regions or choosing parameters tend to be under- smoothing.

If the inverse problems are well-posed, that is, if the relevant parameters or properties of models are known so that the solution depends continuously on the available data, the predominant mode of reasoning is the deductive one. Third, the predominant mode of inference in inverse problems that are well-posed but ill- conditioned is inductive.

Economy of Research in Peirce's Methodeutic

Although C. S. Peirce claimed that he had devoted most of his life to methodeutic, which he defined generally as the study of the "principles of the production of valuable courses of research and exposition", he never produced a definitive account of the contents of this branch of his 'logic in the broad sense'. In the Carnegie Application of 1902, Peirce identified the core concern of methodeutic as heuristic, but he also argued that its first consideration ought to be guidelines and restrictions set by the economics of scientific investigation. While some later commentators have rightly highlighted the relevance of Peirce's pioneering 'Note on the Theory Economy of Research' (1879), relatively little attention has been paid to the question of the central part that this scheme was meant to play in his general account of scientific inquiry. In this paper, I will first identify the central characteristics of Peirce's 'economy of endeavour', and then proceed to an explication of the systemic significance of this doctrine. This exposition will elucidate Peirce's contention that the rules of scientific abduction ought to be based on economic considerations and thereby clarify the vital connection between the logic of discovery and the economy of research. In addition, the discussion will raise some pertinent questions about the relation of cost-effectiveness to the overarching Peircean prohibition against blocking the path of inquiry. I will argue that Peirce's economy of research is most fruitfully comprehended as a regulative methodeutical principle, applicable to virtually any particular field of investigation, yet subordinated to the more general ideal. I will close with some critical reflections on the implications of this appraisal for Peirce's ordering of the sciences and its possible contemporary significance.

Ethical Empiricism and Emotional Interpretants

Justification or evidence for non-normative claims is empirical, by most accounts, and exclusively empirical, by some accounts. But is there such a thing as evidence "of the senses" for normative claims? A positive response has seemed implausible to most, and the possibility of ethics as an empirical science has not been seriously advanced. Since G. E. Moore, non-naturalists have proposed that ethical truths are knowable by intuition, usually understood as a form of a priori knowledge, while ethical expressivists and naturalists have not developed forms of specifically moral epistemology.

In recent work on emotions the view is however emerging that emotion is analogous to perception in being both spontaneous and contentful, and able to justify normative views. I will argue that Charles S. Peirce's semiotic ideas might be fruitfully applied in developing an empirical ethics. Peirce distinguished between emotional, energetic and logical interpretants, which all may have (dynamical) objects of which they may be correct and mistaken. This opens the possibility of revising our ethical views in light of (collateral) emotions, analogously to the revision of (non-normative) theories in light of (collateral) observation. Indeed, the purpose of Peirce's "Study of Great Men" undertaken with his students at Johns Hopkins in 1883–4 was, as he later explains, to "explode the ordinary notions that mathematical treatment is of no advantage when observations are devoid of precision and that no scientific use can be made of very inexact observations" (7.256).

The most central problem for this approach could be titled the causal question: are, say, feelings of indignation towards an action caused by its wrongness? Drawing from Peirce's (original) pragmatism I will suggest that this issue is not due to the specific nature of emotion as opposed to perception and its justificatory powers, but a variant of the more general problem of perception, roughly, that there is no immediate way of distinguishing between a perception of actual objects and illusions. Moreover, I will argue that the causal question is motivated by a simplistic ethical skepticism blocking the way of (scientific) inquiry into ethical questions.

Peirce's First Rule of Reason, and History

The First Rule of Reason is one of the pillars of Peirce's Pragmatism. Peirce describes it as a logical, methodological and epistemological maxim aiming at the cultivation of "the desire to learn". From the maxim, there follows one corollary – Peirce claims – "which itself deserves to be inscribed upon every wall in the city of philosophy: do not block the way of inquiry" (EP2, 48). In this paper I will address the relationship between Peirce's Rule of Reason and his concerns with the history of science. Drawing on archival material, I intend to show that Peirce's Rule of Reason was first formulated in the broader context of a larger body of works that should have eventually converged in a (never completed) book on the History of Science. I will argue that this is not a coincidence, as Peirce's Rule of Reason becomes much more robust when placed in relation to the history of science. Susan Haack (1997) has forcefully argued that, despite the emphasis in current Peirce scholarship on the corollary of Peirce's Rule of Reason, it is indeed Peirce's stress on the desire to learn that deserves philosophical attention, as it constitutes the epistemological and methodological core of Peirce's maxim. Without rejecting her interpretation, I want to show that her argument can be stretched further, to encompass the very context in which the rule was conceived. The desire to learn is the hallmark of genuine scientific research, but this goal can be pursued only with a critical eye to the past. Peirce's Rule of Reason elevates the desire to learn to a normative maxim, but the maxim itself would be empty without a specification of what is it exactly that we learn, and where we learn it from. The historical nature of knowledge is the answer, in this case. By providing concrete examples of logical reasoning in the context of practical action, the history of science prompts a critical relationship with our past that renders it the very fuel of scientific inquiry.

FEYERABEND'S THEORETICAL PLURALISM VS. POPPER'S CRITICAL RATIONALISM CONTINUITIES AND RUPTURES

Friday, August 7 • 14:30–16:30
Main Building, Room 15

After more than five decades since its advancement, the relation of Feyerabend's Theoretical Pluralism (TP) to Popper's Critical Rationalism (CR) continues to be a matter of contention. As is well known, Feyerabend was a former student of Popper and apparently an outspoken advocate of Popper's views when he put forward and developed his methodological proposal in the first half of the 1960s. Advocating a normative conception of methodology, the philosophy of science of CR highlighted the role of empirical refutations of logically consistent conjectural hypotheses for promoting the growth of scientific knowledge through criticism. TP, on the other hand, indicated the proliferation of strong alternatives to an established scientific theory as a most effective way of stimulating the progress of science. Despite its undisputed normativist, critical and falsificationist approach, however, Feyerabend's methodological proposal presented a number of features that seemed to stand in tension with Popper's position and even to be more or less obliquely critical of some of its implications. These include preeminently Feyerabend's notion of incommensurable theories as the strongest, therefore allegedly more fruitful, alternatives to a given, possibly entrenched, theory and his conception of scientific progress as revolution in permanence rather than steady accumulation of knowledge.

Divergent evaluations of the significance of Feyerabend's TP soon emerged and philosophers of science, both within and without the Popperian School, divided over the question whether TP is just an extension of CR, which simply makes explicit, in its sensible aspects, what Popper had left implicit, or whether TP departs from the methodology of CR to such an extent that the former represents a genuine alternative to the latter. The anti-methodological stance that Feyerabend took from the late 1960s as well as the doubts cast on the tenability of TP in the 1970s left the question open. Yet, Feyerabend did not publicly acknowledge any serious flaw in his arguments in favour of TP nor did he actually ever abandon or understate its core.

The recent revival in Feyerabend studies, sanctioned by the first international conference on his thought in 2012 and by a forthcoming special issue of Studies in History and Philosophy of Science, has started reassessing the question, taking advantage of historical distance. On the twentieth anniversary of Popper's and Feyerabend's deaths, the present symposium is designed to focus and delve deeply into the question from different angles, taking stock of the state of the art in current research, profiting from the archival sources which have become available over the last two decades, and advancing novel and firmer interpretations of the relation between TP and CR.

The symposium is composed of three main parts: two 50-minute sections, emphasizing respectively continuities and ruptures between the two positions, and a 20-minute general discussion open to the floor. Every section features two 20-minute presentations, each followed by a 5-minute break in which the speaker could answer short questions of clarification.

SECTION I - CONTINUITIES

Feyerabend and Popper on Theory Proliferation and Anomaly Import

Bschir Karim
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Feyerabend is well known for his positive assessment of theory proliferation. In short, the Principle of Theory Proliferation (PP), as Feyerabend himself calls it, holds that scientific progress is catalyzed by the availability of a number of competing theories. However, Feyerabend not only repeatedly claims that theory proliferation is needed and necessary for scientific progress, but he also provides a reason why he believes this to be the case, i.e. he not only claims that proliferation is a good thing to have, but he also presents a mechanism explaining how the simultaneous presence of contrasting theories leads to scientific revolutions and ipso facto brings about progress. In short, Feyerabend argues that the availability of theoretical alternatives has a magnifying effect on anomalies within well-established theories. This claim goes beyond PP. Accordingly, Hoyningen-Huene, in his discussion of Feyerabend's critique of Kuhn, has given it a separate name, calling it the Anomaly Import Thesis (AIT): Anomalies are imported, as it were, into well-established theories from competing alternatives. Obviously, PP and AIT are closely related. My paper has two objectives: a) To work out the systematic details of Feyerabend's ideas on theory proliferation and anomaly import as they are presented in his early publications and his Against Method; and b) to compare Feyerabend's ideas on theory proliferation and anomaly import with corresponding features in Popper's critical rationalist philosophy of science. I will argue that neither PP nor AIT are necessarily incompatible with CR. Feyerabend's views on theory proliferation and anomaly import must be seen as a variation of certain ideas that Popper had already formulated in The Logic of Scientific Discovery and elsewhere. In spite of Feyerabend's anti-Popperian attitude, I claim that TP can be seen as an advancement of the critical rationalist philosophy and that CR provides good arguments for pluralism.

A Sorcerer's Apprentice or How Feyerabend Transmuted Critical Rationalism into Theoretical Pluralism and Got Cursed with Incommensurability

Collodel Matteo
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This paper presents a detailed reconstruction of the argument through which Feyerabend introduced TP in "Explanation, Reduction, and Empiricism" (1962) as well as of the process of its composition. It is shown not only that the original premises of Feyerabend's argument have a distinctively Popperian pedigree, but also that their use was influenced by inputs that Feyerabend received directly from his mentor in 1959-60.

On the basis of the argumentative structure of Feyerabend's essay, TP is to be considered as the normative or methodological counterpart of his descriptive Incommensurability Thesis (IT). Whereas both IT and TP bear some debt to Popper's views, TP more especially is the result of the combination of two basic tenets of the philosophy of science of CR: (i) the methodological preference for maximally falsifiable theories, the degree of falsifiability of a scientific theory being proportional to its empirical content, i.e. to the size of the class of its potential falsifiers; and (ii) the idea that observational evidence is theory-laden. An extreme interpretation of (ii) led Feyerabend to deny that phenomena relevant to T can be correctly perceived and described from within T's conceptual framework and, as a consequence, to claim that the empirical content of T is partly dependent on theories that are alternative to it. Accordingly and elaborating upon (i), Feyerabend thought of theories semantically incommensurable with T as the strongest possible alternatives to it, therefore guaranteeing its highest possible falsifiability. However, thus conceived incommensurable theories turn out to be logically disjoint, i.e. radically incompatible beyond the expressive capability of negation as a logical operator; which undermines the falsificationist rationale of Feyerabend's argument. So, in distilling TP out of CR, Feyerabend stretched Popper's views to such an extreme limit that he lost control of the consequences of his magic performance.

SECTION II - RUPTURES

Feyerabend and Popper on Progress and the Aim of Science

Tambolo Luca
Università di Trieste, Gorizia, ITALY

Feyerabend's and Popper's views on theory proliferation are discussed and related to three theories of progress: (i) the theory of progress as increasing explanatory power, advocated in Popper's The Logic of Scientific Discovery (1935/1959); (ii) the theory of progress as approximation to the truth, introduced in his Conjectures and Refutations (1963); and (iii) the theory of progress as a steady increase of competing alternatives, which Feyerabend put forward in "Reply to Criticism" (1965).

The mixed standing of the pluralistic model of theory testing that Feyerabend proposed in "Explanation, Reduction and Empiricism" (1962)—revolving around the claim that a severe test of a theory T requires to take into consideration not only the available evidence, but also alternatives to T—is emphasized: although the model originated within an unmistakably falsificationist framework, by the mid-1960s it evolved in such a way as to make it incompatible with Popper's ideas on proliferation. More specifically, Feyerabend's understanding of the notion of empirical content, his insistence on the importance of discredited theories, his putting the notion of incommensurability into the service of proliferation, and his embrace of the theory of progress as a steady increase of competing alternatives that do not converge towards the truth, led him to step out of the falsificationist framework. However, also Popper's ideas concerning the aim of science evolved: while in the 1930s he had defended a theory of science in which the concept 'true' was avoided, in Conjectures and Refutations he advocated that progress can be accounted for in terms of the increasing approximation to the truth of our theories, and was the first to devise a formal explication of the notion of verisimilitude. We suggest that such a change in Popper's axiological commitments is an underestimated factor that contributes to account for Feyerabend's changing attitude towards falsificationism.

How Feyerabend's Theoretical Pluralism Is Incompatible with Popper's Critical Rationalism

Oberheim Eric
Bielefeld Universität, Berlin, GERMANY

Recent publications have challenged the view that Feyerabend's TP is incompatible with Popper's CR. For example, apparent similarities between Feyerabend and Popper's views that purportedly support this attack have been highlighted and it has also been suggested that Feyerabend's TP is more Popperian than has been widely supposed. This paper argues that these conclusions are based on misrepresentations of Feyerabend and Popper's views. Feyerabend's TP is based on an idea of the role of incommensurable rivals in theory testing that undermines the central pillar of Popper's critical rationalism: his deductivist account of the logic of science (commonly known as falsificationism). Moreover, Popper and Feyerabend's incompatible views on theory testing lead Feyerabend and Popper to incompatible accounts of scientific advance.

The argument runs as follows. Popper's main claim is that the logic of science is deductive, not inductive. Systems of proposed hypotheses are tested against experience by deducing basic statements from them (with the help of auxiliary assumptions) that can be used to test them. This leads to their falsification or corroboration. According to Feyerabend's TP, sometimes theories can be tested on the basis of statements of facts that cannot be deduced from them. For example, particular statements of facts about the statistical behavior of Brownian motion refute classical phenomenological thermodynamics, but (according to Feyerabend) these facts could not have been deduced (or even established) from within its conceptual framework. An incommensurable rival, the kinetic theory of heat, was needed to establish these facts. If Feyerabend is correct, then Popper's falsificationist account of theory testing requires revisions that allow for empirically testing incommensurable scientific theories. Feyerabend's TP is best understood as an attempt to make such revisions.

MATHEMATICAL BEAUTY: A CHALLENGE FOR EMPIRICALLY INFORMED PHILOSOPHY OF MATHEMATICS

Friday, August 7 • 14:30–16:30
Main Building, Auditorium II

Organizer:
Schlimm Dirk
Philosophy, McGill University, Montreal, CANADA

This symposium is organized by the corresponding author, who is NOT a speaker at the symposium. The aim of this symposium is to present some recent philosophical and empirical work on mathematical beauty as the basis for a discussion of some of the methodological challenges that are raised for philosophy by the use of empirical methods. In the past decades, philosophy of mathematics has increasingly turned away from treating mathematics as an idealized and static subject matter and has moved towards incorporating episodes from the history of mathematics and views expressed by individual mathematicians into its analyses. More recently, also work from cognitive science and results from empirical studies have been taken into consideration. The participants of this symposium have all, in one way or another, contributed to these latter developments. For the case of mathematical beauty in particular, Inglis and Aberdein (2014) have probed the judgments of working mathematicians about aesthetic properties of proofs. They asked 255 mathematicians to think of a proof they'd recently read, and state how well each of 80 adjectives described it. Their results cause problems for classical accounts of mathematical beauty: for instance, there was no significant correlation between a proof's perceived level of beauty and its perceived level of simplicity or explanatoriness. They argued that this result poses a serious challenge to traditional approaches in philosophy of mathematics, which often focus on the philosopher's intuitions or on a single case study to draw some general philosophical conclusions; for example, Euclid's proof of the infinitude of prime numbers or proofs of Pythagoras' Theorem are often discussed as "beautiful" proofs and their analysis then is supposed to give us universal insights into the notion of mathematical beauty. This symposium is intended as a forum to discuss how this challenge can be met from the point of view of an empirically informed philosophy of mathematics, i.e., without dismissing the empirical findings as being irrelevant for philosophical analyses. The invited participants have all worked on the problem of characterizing mathematical beauty, from a number of different perspectives, which include aesthetics, mathematical cognition, and mathematical education. Thus, this symposium promises to advance both the philosophical discussion of mathematical beauty as well as the methodological reflections that are prompted by the recent opening of philosophy of mathematics to inter-disciplinary approaches. The format of the symposium will be four talks (20min each with 5min for questions) and a final general discussion with all participants (20min).

Abstracts of individual papers (max. 300 words each):

Diversity in proof appraisal

Matthew Inglis
Loughborough University, Loughborough, UNITED KINGDOM
Andrew Aberdein
Florida Institute of Technology, Melbourne, FL, USA

We investigated whether mathematicians typically agree about the qualities of mathematical proofs. Between- mathematician consensus in proof appraisals is an implicit assumption of many arguments made by philosophers of mathematics, but to our knowledge the issue has not previously been empirically investigated. We asked a group of 112 mathematicians to assess a specific proof on four dimensions, using the framework identified by Inglis and Aberdein (2014). We found widespread disagreement between our participants about the aesthetics, intricacy, precision and utility of the proof, suggesting that a priori assumptions about the consistency of mathematical proof appraisals are unreasonable.

Beauty in the eyes of the beholder? Approaching mathematical beauty in an empirically-informed way

Dutilh Novaes Catarina
University of Groningen, Groningen, NETHERLANDS

It is well known that mathematicians often attribute aesthetic properties such as 'beautiful', 'elegant', 'ugly' etc. to proofs. However, there is no consensus among mathematicians and philosophers on how to interpret these judgments: are aesthetic properties primary, indefinable features of mathematical proofs, or are these aesthetic terms used to refer, in a roundabout way, to non-aesthetic properties? A case in point: Montano (2013) introduces the useful distinction between literal and non-literal interpretations of aesthetic vocabulary in mathematics; he sides with McAllister to defend the literal interpretation, against Rota's non-literal interpretation of 'beauty as enlightenment'. But what kind of 'data' could count as evidence in this debate? So far the debates have been mostly conducted on a purely conceptual level, but the recent publication of Inglis

and Aberdein (2014) opened up a new, empirical way to approach these issues. Some of the pertinent questions that can be investigated empirically are: do mathematicians converge in their attributions of aesthetic properties to mathematical proofs? Are there significant correlations between attributions of certain aesthetic properties and attributions of non-aesthetic properties to a given proof? Answers to these questions would provide important (even if not decisive) data for the issues surrounding the phenomenon of aesthetic judgments in mathematics. For example, if it turns out that mathematicians by and large agree on their attributions of aesthetic properties to specific proofs, this would lend support to the idea that these are 'robust', primary features of mathematical proofs. In contrast, if there is no convergence, then we may conclude that for proofs too, 'beauty is in the eyes of the beholder', not in the proofs themselves. In my talk, I will raise some of the questions that could be investigated empirically, discuss existing results, and draw implications of these results for some of the philosophical questions pertaining to beauty in mathematics.

Approaches to mathematical aesthetics

Marcus Giaquinto
University College London, London, UNITED KINGDOM

This talk will cast doubt on both of two opposing views about how to investigate mathematical aesthetics. One view recommends philosophical reflection without regard to the findings of empirical studies. The other recommends taking empirical findings about aesthetic (and other) judgments at face value and using them as the basis of one's philosophical conclusions. Looking at one or two empirical studies, I will try to give my reasons and (time permitting) make some positive suggestions about the right approach.

There is no beauty there

Raman-Sundström Manya
Umeå University, SWEDEN

This paper explores the possibility that when it comes to beauty in mathematics, we oversubscribe, attributing properties of beauty where there may be none. We take as an example a topologist at a moment of insight. When interviewed about this moment she claimed there was nothing aesthetic about it—she just wanted to produce new mathematics and this was her result. Work on philosophical questions using empirical methods is increasingly common (e.g. Knobe (2008), Inglis and Aberdein (2014)). However this example raises questions of what we can reliably infer about our data. The term "beauty" has a wealth of connotations and its own place in mathematical lore. However this does not mean we cannot make progress on what the term means, regardless of what people say.

COMPUTATIONAL FINITISM AND CONCRETE FOUNDATIONS OF MATHEMATICS

Friday, August 7 • 17:00–19:00
Main Building, Room 7

Czarnecki Marek
Warsaw University, POLAND
Mostowski Marcin
Warsaw University, Warszawa and Jagiellonian University, POLAND
Godziszewski Michał Tomasz
Warsaw University, POLAND
Kalociński Dariusz
Warsaw University, POLAND

Contemporary mathematics makes significant use of notions which belong to *ideal mathematics* (in Hilbert's sense [Hil02]). The latter is expressed in language essentially employing the concept of actual infinity. However, with an appropriate syntax coding assumed, we may not hope for a meaningful definition of the notion of truth for such a language. The best thing we have is its reduction to suitable axiomatic theories. Nevertheless, by the Gödel's theorem, this reduction cannot be complete, and moreover the truth of the axioms is left open.

On the other hand, we can easily decide the truth or falsity of a statement in finite structures by simple computation. Therefore, a natural question arises: how much of mathematics can be interpreted in finite models? Obtaining an answer to this question seems to be of high importance.

To approach the question, we consider *sl*–semantics and FM–domains developed by M. Mostowski in [Mos01] and [Mos12]. We restrict our attention to infinite growing sequences of finite models over a purely relational vocabulary such that the initial segments of natural numbers are the domains of these models. Let $R \subseteq \mathbb{N}^r$ be an arithmetical relation. Then by $R^{(n)}$ we denote $R \cap \{0, 1, \ldots, n-1\}^r$. For any model $\mathcal{A}$ over the vocabulary $\sigma = (R_1, \ldots, R_k)$ we define the FM–domain of $\mathcal{A}$ as follows: $\mathrm{FM}(\mathcal{A}) = \{\mathcal{A}_n : \ n = 1, 2, \ldots\}$, where $\mathcal{A}_n = (\{0, 1, \ldots, n-1\}, R_1^{(n)}, \ldots, R_k^{(n)})$.

For any $\varphi \in Sent_\sigma$ we say that φ is *sl*–true in FM($\mathbb{N}$) (true in sufficiently large models, hence the shortcut *sl*), denoted by: $\mathrm{FM}(\mathbb{N}) \models_{sl} \varphi$ if and only if $\exists m \forall k \ (k \geq m \ \Rightarrow \ \mathbb{N}_k \models \varphi)$. Let us then denote:

$$sl(\mathrm{FM}(\mathbb{N})) = \{\varphi \in Sent_\sigma : \ \exists m \forall k \ (k \geq m \ \Rightarrow \ \mathbb{N}_k \models \varphi)\}.$$

More generally we could say that for a given class $\mathcal{K}$ of finite models

$$sl(\mathcal{K}) = \{\varphi \in Sent_\sigma : \ \exists n \forall \mathcal{M} \in \mathcal{K} \ (card(\mathcal{M}) \geq n \ \Rightarrow \ \mathcal{M} \models \varphi)\}.$$

A set of sentences T *sl*–entails a formula φ, denoted by: $T \models_{sl} \varphi$ if and only if for any given class $\mathcal{K}$ of finite models we have:

$$\text{if} \quad \mathcal{K} \models_{sl} T, \quad \text{then} \quad \mathcal{K} \models_{sl} \varphi$$

We say that the relation $R \subseteq \mathbb{N}^r$ is FM–represented by a formula $\varphi(x_1, \ldots, x_r)$ if and only if for each $a_1, \ldots, a_r \in \mathbb{N}$ both of the following conditions hold:

(i) $\mathrm{FM}(\mathbb{N}) \models_{sl} \varphi(a_1, \ldots, a_r)$ if and only if $R(a_1, \ldots, a_r)$.

(ii) $\mathrm{FM}(\mathbb{N}) \models_{sl} \neg\varphi(a_1, \ldots, a_r)$ if and only if $\neg R(a_1, \ldots, a_r)$.

We say that R is **FM–representable** if there is an arithmetical formula φ such that it FM–represents R.

Let us observe that FM–representability of R means that each question of the form "$R(a_1, \ldots, a_r)$?" can be decided in sufficiently large finite models by a single formula. It is shown in [Mos01] that FM–representability is equivalent to being recursive with recursively enumerable oracle. Another characterization of this class is described by R. L. Epstein [Eps79] as "constructive limits of constructive procedures" and he points that they "have the same flavor as arguments in other areas of finite mathematics, such as number theory or graph theory".

Traditionally such notions could be called, following Hilbert, *finitistic*. Nevertheless, this term is essentially overloaded. Therefore, following the terminology used by Knuth for denoting the part of mathematics with computational relevance, we use terms *concrete mathematics*, *concrete semantics*, etc., for the concepts which can be correctly represented in finite models.

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Concrete mathematics – finitistic approach to foundations of mathematics

We discuss the problem of how much mathematics can be put into concrete framework? It means: how much mathematics can be correctly described in sufficiently large finite models? One of the examples is *computer mathematics* — mathematics carried out inside memory of our computing devices. Another one is finite interpretation of analysis given by J. Mycielski, given in his paper "Analysis without actual infinity" (JSL 1981).

Dealing with axiomatic theories can be easily put into concrete framework. Proofs are finite objects. They can be described and analyzed in sufficiently large finite models. The case of semantics is slightly less obvious. On the basis of the FM–representability theorem — which identifies the discussed notion with Δ^0_2–definabilty or computability with recursively enumerable oracle — we obtain a few easy results. One of the most interesting, among them, is a computational version of the completeness theorem given by Kleene. It implies that each consistent axiomatic theory has a concrete model.

We search for concrete constructions in algebra and model theory. For example, for every concrete Boolean algebra $\mathbb{B}$ and every non-zero element $b \in \mathbb{B}$ there is a concrete ultrafilter $\mathcal{U}$ such that $b \in \mathcal{U}$.

Concrete model theory. Model-theoretic constructions without actual infinity

We investigate a part of model theory which is meaningful without actual infinity. We assume the notion of FM–representability as an explication of expressibility without actual infinity.

By model theory we do not mean the axiomatic model theory that is performed in some axiomatic set theory i.e. what currently is understood as model theory. Our aim is to develop *concrete* model theory — a theory about structures, which can be presented in a finitistic way, and their properties.

We consider concrete models. For a finite relational vocabulary $\sigma = (P_1, \ldots, P_m, C)$ a concrete σ–structure is a sequence of arithmetical formulas $(\varphi_U, \varphi_{P_1}, \ldots, \varphi_{P_m}, \varphi_{C,U})$ which FM–represents a σ–model in the standard model-theoretic meaning. A concrete σ–model is a pair $(\mathcal{F}, \varphi_{\models})$, where $\mathcal{F}$ is a concrete σ–structure and $\varphi_{\models}$ FM–represents the satisfaction relation on $\mathcal{F}$.

We show how to express basic concepts of model theory in the language without actual infinity. We focus on model-theoretic constructions known from the axiomatic model theory to identify which of them remain valid in the *concrete* framework and which include some steps essentially requiring the use of actual infinity. We show both positive and negative examples of such constructions. For the latter we identify the steps which are not feasible in this new framework i.e. these that applied to concrete models may result in obtaining non-concrete models. As an example of difficulties that arise when dealing with concrete models we can point that, existence of a concrete embedding f between concrete models $\mathcal{A}$ and $\mathcal{B}$ does not mean that the image $f[\mathcal{A}]$ is a concrete submodel of $\mathcal{B}$ – in fact $f[\mathcal{A}]$ may be a non-concrete model. It means that our usual practice of identifying a model with its isomorphic image under the embedding does not work for concrete models. This makes constructions of concrete chains of concrete models harder than in axiomatic model theory, however still possible.

We present the following:

- the Concrete Completeness Theorem and the Low Completeness Theorem
- the Concrete Omitting Types Theorem
- the Concrete Preservation Theorems.

We also show that Robinson's construction and Chang-Keisler's Σ_n chains construction fail in the concrete models context.

An infinite liar in a potentially infinite world

We present Mostowski's theorem on the undefinability of truth in finite models and show a certain property of the theory of FM–domain of the standard model of arithmetic equipped with the additional truth predicate. Namely, we examine the properties of Yablo sequences in FM–domains. These are sequences of sentences employing the notion of truth that serve as a *litmus paper* of certain logical properties of the arithmetical theories of truth.

Yablo sequence is the following infinite sequence of sentences:

$$\begin{gathered} Y_0 = \forall k > 0 \ \neg Tr(Y_k) \\ Y_1 = \forall k > 1 \ \neg Tr(Y_k) \\ \ldots \end{gathered}$$

It is easy to observe, that neither of the sentences in the list can be true nor false.

We define the formal notions of **Yablo formulae**, **Yablo sentences** (satisfying the Yablo condition w.r.t. a theory T) and the schemes of **Local Arithmetical Disquotation** (AD) and **Local Yablo Disquotation** (YD):

$$\begin{aligned} AD &= \{Tr(\overline{\ulcorner\varphi\urcorner}) \equiv \varphi : \varphi \in \mathrm{Sent}_{\mathcal{L}} \ (Tr \text{ does not occur in } \varphi)\}, \\ YD &= \{Tr(\overline{\ulcorner Y(\overline{n})\urcorner}) \equiv Y(\overline{n}) : Y(\overline{n}) \text{ belongs to the Yablo sequence}\}. \end{aligned}$$

We modify FM($\mathbb{N}$) by adding to its every element $\mathbb{N}_k$ an interpretation T_k of the truth predicate Tr.

Definition 1 FM$(\mathbb{N})^T$
Let $\mathcal{K} = \{(\mathbb{N}_k, T_k) : k \in \omega$ and $T_k \subseteq \{0, \ldots, k-1\}\}$. An FM$(\mathbb{N})^T$–domain is any subset of $\mathcal{K}$ such that for any natural m it contains exactly one model of the cardinality m.

Theorem 1 *There exists a formula $Y(x)$ such that for any FM$(\mathbb{N})^T$–domain we have:*
$\forall n \in \omega\, \mathrm{FM}(\mathbb{N})^T \models_{sl} Y(n) \equiv \forall x (x > n \Rightarrow \neg Tr(\ulcorner Y(\dot{x})\urcorner))$, *i.e. Yablo sentences exist in $sl(\mathrm{FM}(\mathbb{N})^T)$.*

Theorem 2 *For any class $\mathcal{K}$ of finite models, if $\mathcal{K} \models_{sl} AD + YD$, then for all $n \in \omega$ $\mathcal{K} \models_{sl} \neg Y(n)$. In other words, for each natural n, $YD \models_{sl} \neg Y(n)$.*

We also show a construction of a class $\mathcal{K}$ such that $\mathcal{K} \models_{sl} AD + YD$, which means that the satisfaction of the premise of the theorem is not empty.

It is also useful to notice that:

Theorem 3 *For any class $\mathcal{K}$, if $\mathcal{K} \models_{sl} YD$, then for sufficiently large $\mathcal{M} \in \mathcal{K}$, there is exactly one $n \in \omega$ s.t. $\ulcorner Y(n)\urcorner \in T_{\mathcal{M}}$.*

The results mean that under the logic of sufficiently large finite models YD entails $\neg Y(n)$ for any natural n, i.e. YD entails that all the Yablo sentences are false in the limit.

Learnability thesis, FM–representability and low models of WKL_0

We consider the notion of intuitive learnability and its relation to intuitive computability. We briefly present and discus the Church's Thesis. Then we define the class of intuitively learnable sets. A set is intuitively learnable if there is a (possibly infinite) intuitive procedure that for each input produces a finite sequence of yeses and nos such that the last answer in the sequence is correct. Further, we formulate the Learnability Thesis which states that the notion of intuitive learnability is equivalent to the notion of algorithmic learnability. Our claim is analogous to the Church's Thesis.

We analyse the argument in favour of the Church's Thesis presented by Mostowski. It goes in unusual lines – by giving a model of the class of growing (i.e. increasing in terms of cardinality) finite arithmetical models, namely $\mathrm{FM}(\mathbb{N})$, separating knowable (intuitively computable) sets from the FM–representable (algorithmically learnable) ones and showing that knowable sets are exactly recursive. We indicate which assumptions of the Mostowski's argument implicitly include that Church's Thesis holds (considering the FM–domain of the finite cuts of an arithmetical model in which all predicate symbols have recursive interpretationsis actually equivalent to assuming that intuitively computable relations are exactly recursive ones. The impossibility of success with this kind of argument is strengthened by showing that the Learnability Thesis does not imply the Church's Thesis. Specifically, we show a plausible interpretation of intuitive computability under which intuitively learnable sets are exactly algorithmically learnable but intuitively computable sets form a proper superset of recursive sets — the result follows from the existence of an expansion of the $\mathrm{FM}(\mathbb{N})$ to $\mathrm{FM}(\mathbb{N}, A)$, where A is a low set, i.e. such that $\deg(A)' = 0'$.

The main new result of the paper is a generalization of the abovementioned theorem to an $\mathrm{FM}(\mathbb{N}, \{A_i\}_{i\in\omega})$, where $\{A_i\}_{i\in\omega}$ is a family of low sets. We show the connection of the existence of particular ω-models of the subsystem of second-order arithmetic WKL_0 that is guaranteed by the low basis theorem (formalized within the theory of arithmetical comprehension ACA_0). Finally, we show that for such an expansion of the FM–domain it is necessary to modify the notion of learnability to non-uniform learnability and assume that we have a family of learning algorithms for finite approximations of the low sets from the class $\{A_i\}_{i\in\omega}$.

FOUNDATIONS OF DEFEASIBLE REASONING

Saturday, August 8 • 10:00 –12:00
Main Building, Auditorium IV

Organized:
Beirlaen Mathieu
Instituto de Investigaciones Filosoficas, Universidad Nacional Autonoma de Mexico, Mexico City, MEXICO
Straßer Christian
Institute for Philosophy II, Ruhr-University Bochum, Bochum, GERMANY

Defeasible reasoning (in short, DR) is indispensable when dealing with a world full of uncer- tainties: we constantly draw conclusions that we may reject later in view of new information. Examples of DR are numerous: induction, inference to the best explanation, inferences on the ba- sis of expert opinions, reasoning in the presence of inconsistencies, reasoning with priorities, etc. In our everyday practice as well as in the practice of experts or scientists, defeasible inferences are abundant.

The formal study of DR took off in the later decades of the previous century. From these investigations a number of different approaches arose, each with their own intended contexts of application. Reiter developed his formalism of default logic for dealing with conditionals subject to exceptions; the works of Pollock and Dung spawned a tradition in argumentation- based approaches to DR; and Adams and Pearl pioneered a probabilistic view. Next to these influential proposals, there is a wide variety of formalisms and frameworks for representing DR, including inheritance nets, adaptive logics, logics for belief revision, update semantics, etc.

Nowadays these formal tools for studying DR are ubiquitous. Default logic is being put to work in philosophical debate (see Horty 2012), argumentation frameworks are widely used in artificial intelligence, and recently it was argued that probabilistic approaches to DR are provoking a paradigm switch in the psychology of reasoning (Pfeifer & Douven 2014).

Notwithstanding the plethora of approaches to DR and their omnipresence in the literature, each suffers from its own shortcomings, and there are still many foundational issues in this field. With this symposium, we aim to bring the different foundational approaches to DR in dialogue and to identify the most urgent research challenges in this domain. To this end, we give the floor to representatives of each of the three influential approaches mentioned above, i.e. default logic (Aldo Antonelli), argumentation theory (Leila Amgoud), and the probabilistic take on DR (Niki Pfeifer).

References: Horty, J. Reasons as Defaults. OUP, 2012. Pfeifer, N. & Douven, I. Formal epistemology and the new paradigm psychology of reasoning. Rev. Phil. Psych. 5: 199-221 (2014)

Cognitive foundations of defeasible reasoning

Pfeifer Niki
LMU Munich, GERMANY

Probabilistic rationality frameworks for defeasible reasoning have become popular in formal epistemology and more recently in the psychology of reasoning. The formalization of indicative conditionals in terms of conditional probability is both philosophically and psychologically appealing: it allows for dealing with uncertainty and defeasibility which are almost always present in reasoning about everyday life conditionals.

In this talk, I will critically discuss cognitive foundations of defeasible reasoning about uncer- tain indicative conditionals. Specifically, I will review psychological data on how people interpret indicative conditionals, on how they reason in the context of the basic nonmonotonic reasoning System P and in its respective monotonic counterparts. Moreover, I will reinterpret the results of the so-called suppression tasks and the classical truth table tasks in the light of probability theory, and argue that human inference is not irrational, as classical logic is violated in these tasks. Rather, I explain why these results are impressive demonstrations of the human defeasible reasoning competence. Finally, I will assess in how far the interaction of formal and experimen- tal work in general can pave the way towards a normative and descriptive appealing theory of defeasible inference, without being too psychologistic.

Formal Properties of Default-Based Inference

Antonelli G. Aldo
University of California, UNITED STATES

Default rules provide a flexible framework for the formalization of defeasible inference by providing a direct representation of the conclusions that can be reached on the basis of a given knowledge base once certain other side condition are met. These side conditions, typically, express consistency constraints that not only have to be met upon entering the inferential cycle (i.e., in order for the rule to be triggered), but also have to be met upon exiting the inferential cycle. This gives rise to the possibility of conflicts, for instance when the firing of a given rule pre-empts — either directly or indirectly — those very side conditions.

Default logic provides a theoretical account of how, and when, such conflicts can be resolved, by identifying the set of consequences obtainable from a given default theory as a reflective equilibrium or "fixed-point" solution. However, the nature of the solution makes it difficult to achieve certain desirable formal properties that, together, characterize defeasible inference as the sort of cumulative process that human reasoners engage in when reaching conclusions that can be retracted in the light of new information.

This talk is intended as a presentation of these issues, highlighting the differences between default-based and probabilistic inference, as well as between the bold and skeptical approaches to defeasible inference. and indicating one possible strategy for constructing a formally well- behaved relation of defeasible inference. In particular, we will focus on Cautious Monotony, which we present as crucial for the characterization of defeasible inference — in the skeptical framework — as a cumulative process.

Argumentation as an alternative approach for defeasible reasoning

Amgoud Leila
IRIT, Université Paul Sabatier, Toulouse, FRANCE

Argumentation is an alternative approach for defeasible reasoning. It is based on the idea of justifying plausible conclusions by "strong" arguments. Starting from a knowledge base encoded in a logical language, an argumentation system defines arguments and attacks between them using the consequence operator associated with the language. Finally, it uses a semantics for evaluating the arguments. The plausible conclusions to be drawn from the knowledge base are those supported by "good" arguments. In this talk, we present two families of such systems: the family using extension semantics [1] and the one using ranking semantics [2]. We discuss the outcomes of both families and compare them. We then compare the argumentation approach with other well-known approaches for defeasible reasoning, namely default logic [3] and KLM logics [4]. We show that the latter can be captured by argumentation systems, and discuss other advantages of argumentation.

References: [1] P.M. Dung. On the Acceptability of Arguments and its Fundamental Role in Non-Monotonic Reasoning, Logic Programming and n-Person Games. Art.Int., 77:321–357, 1995. [2] L. Amgoud and J. Ben-Naim. Ranking-based semantics for argumentation frameworks. In SUM, 134–147, 2013. [3] A logic for default reasoning. Art.Int., 13(1-2):81–132, 1980. [4] S. Kraus, S. Lehmann, and D. Magidor. Nonmonotonic reasoning, preferential models and cumulative logics. Art.Int., 44:167–207, 1990.

SYMPOSIA

INVESTIGATIONS INTO THE MEANING OF LOGICAL CONNECTIVES

Saturday, August 8 • 10:00–12:00
Main Building, Room 13

Quine's famous meaning-variance argument in [8], encapsulated in the provocative slogan "change of logic, change of subject", implicitly assumes what can be called semantic maximalism for logical connectives (see [9]; 'semantic maximalism' for short), that is, the idea that all of the model-theoretic or proof-theoretic elements associated to a connective contribute to its meaning. Semantic minimalism --the idea that only some of the model-theoretic or proof-theoretic elements associated to a connective contribute to its meaning-- has won many advocates during the last two decades after its initial formulation and defense by Putnam [7]. Which of those components do actually make a semantic contribution and why them and only them do so is far more controversial.

In the proof-theoretic side, the distinction between local meaning (embodied in operational rules for connectives) and global meaning (obtained when structural rules are taken into account) is more or less widely accepted and has been the preferred setting to formulate and defend semantic minimalism [3], although there have been model-theoretic attempts [2, 9, 5]. But although it is pretty clear that a natural deduction system does not do the required work and a sequent system is preferable, it is dubious that it is enough [4, 6]. In particular, problems arise when one tries to combine views on the meanings of connectives and stances on issues like that of meaning-variance (difference of logic implies difference in the meaning of their connectives) or logical pluralism (there is more than one true logic, see [2]), so our formal and conceptual toolboxes need to be enriched [1], whether by deploying existing techniques or notions in new ways, or by further refining concepts by letting some of their traditionally equivalent guises come apart.

Finally, there is the recent relativist account in [10] according to which questions of meaning-variance is context-sensitive and interest-relative.

In this symposium we aim at examining the problem of the meaning of logical connectives by dealing with the following questions and some other in the vicinity:

"(generalized) Putnam's challenge": Which components associated to a connective are meaning-contributive and why?

If logical notions are maximally general, can global meaning, with the particularities introduced by the structural rules, be considered as a genuine kind of meaning of a logical notion?

Proof-theoretic notions and methods have dominated the debate on semantic minimalism. Is there a reasonable way to at least reproduce in model-theoretic terms the good features of the usual proposals? Are there any prospects to get additional illuminating insights when framing the discussion in model-theoretic terms?

Can there be a uniform (minimalist) account of the meaning of connectives for object language connectives and structural connectives (like the comma or the sequent indicator), or including even the notion of validity or consequence?

What is a meaning for a connective after all? In particular, how is meaning to be defined to better assess judgments of meaning-variance, synonymy and the like? How does meaning relate to, for example, content?

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Reassessing the Quinean challenge

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Free University of Brussels, BELGIUM

The goal of this contribution is to take a few steps back, and put in perspective our reasons for trying to avoid meaning-variance as a means to, first, save the possibility of genuine rivalry between different logics, and, second, safeguard the very idea of logical revision. One reason for this re-examination is that if we understand better why meaning-*in*variance across logics matters, we will also have a better idea of which kind of answer is satisfactory. Indeed, the hope could be that we can also delineate which types of counter-objections can summarily be dismissed once a good answer to the Quinean challenge has been given.

As part of the proposed inquiry, three complementary perspectives will be adopted. First, we will reconsider the stances of Carnap and Kreisel with respect to formal and informal rigour; second, we will take some lessons from the distinction between data and phenomena (as used in the context of conceptual modelling by Löwe and Müller); finally, we shall revisit the problem of meaning (in-)variance in informational conceptions of logic, and particularly in view of the inverse relationship between logical discrimination and deductive strength.

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Displaying model theory

Estrada-González Luis
National Autonomous University of Mexico, MEXICO

Most attempts at showing a meaning-invariance between logical connectives of different logics have been carried out in rule-based theories and methods. In this talk I will advance a model-theoretic approach to meaning-invariance with two specific components. The first of them is what I call "the displaying of the model theory", that is, a presentation of truth-conditions in which one could display any element of a specific truth-condition, just as display calculi in proof-theoretic semantics are intended to display any part of a sequent. The second component is the identification of those elements of specific truth-conditions that are meaning determining (roughly, the type of truth-condition it is) and those that are not (roughly, anything else that makes a type of truth-condition into a specific truth-condition). If there is time, I will advance an argument against the idea that global meaning should count as a meaning for a logical notion and one against the relativist approach of Shapiro.

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Structuralism vs intra-theoretic pluralism

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University of Cagliari, ITALY

In two recent papers ([2], [3]), Ole Hjortland has defended two different, though related, versions of logical pluralism: structuralism and intra-theoretic pluralism. Structuralism is the view according to which, not unlike what happens in other domains of science, the transition from an old to a new logic is a process in which "the mathematical structure of the preceding theory survives as a special, limiting case of the new theory" [3]. Intra-theoretic pluralism "is a pluralism not of logical theories but of logical consequence relations within one and the same theory" [2, p. 11]. I will compare these two viewpoints and discuss the extent to which they can salvage the current revisionary debates in logic, guaranteeing that there can be genuine rivalry between different (propositional) logics. A substantial part of this inquiry will involve the attempt to move beyond the individual examples of logical competition offered by Hjortland to instantiate his two concepts, and to formulate a general and purely abstract sufficient condition for genuine rivalry between logics –along the lines of what was done in [4] in the context of a minimalistic account of the meaning of logical constants. In this process, I repeatedly resort to the toolbox of abstract algebraic logic, in particular matrix semantics. The difficulties encountered along the way shed some light, in my view, on the limits and prospects of both approaches. In passing, I also comment on Allo's rejoinder to [2] (his [1]), centered on the role of synonymy.

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RECENT PROGRESS IN FORMAL THEORIES OF TRUTH

Saturday, August 8 • 13:30–15:30
Main Building, Auditorium IV

Cieśliński Cezary
University of Warsaw, POLAND
Łełyk Mateusz
University of Warsaw, POLAND
Wcisło Bartosz
University of Warsaw, POLAND
Godziszewski Michał Tomasz
University of Warsaw, POLAND

Contemporary conceptions of truth can be divided into two broad categories: philosophical and logical ones. Admittedly the division is not sharp, nor it should be: philosophers need formal results and the logicians often take philosophical intuitions into account in their formal constructions. Any intuitive conception of truth has to pass the test of formalization in order to count as valid or at least promising. On the other hand, formalizations, once proposed, can be investigated with rigorous methods and confronted with intuitive conceptions which stand behind them. A formal *theory of truth* is an extension of some base theory of syntax (this role can be played, for example, by Peano arithmetic) with new axioms, describing the behavior of the unary predicate $T(x)$, with the intended reading "x [is a Gödel code of a sentence, which] is true". Axiomatic theories of this sort can be thought of as formal frameworks, making possible a rigorous analysis of informal philosophical views on truth.

Recent results in formal investigations on truth will be presented at the symposium. We plan to consider several directions of research. One of them is an analysis of weak theories of truth - theories build over Peano arithmetic and conservative over their base theory. Philosophical importance of conservativity, both in the syntactic and the semantic sense, will be discussed in the first talk of the symposium; formal aspects will be developed in other talks.

Another direction is an analysis of theories with full arithmetical induction, but containing only some weak and restricted form of induction for formulas with the truth predicate. One can ask how strong weak induction is over a chosen axiomatic truth theory, with many questions of this sort still remaining open. However, for some of these questions, solutions will be provided at the symposium.

The research presented at the symposium belongs to the realm of formal philosophy – an approach in which advanced logical and mathematical tools are applied to the analysis of philosophical issues. This way of doing philosophy has proved particularly fruitful and its current popularity is fully well-deserved. Investigations on formal truth theories should be viewed as a part of this broader trend.

The proposed symposium will consist of four parts:

1. *The Innocence of Truth.* In this talk we will discuss the philosophical importance of truth theories, which are conservative over their base theories of syntax.

2. *Models of Weak Theories of Truth.* We focus here on relations between classes of models of truth theories, which are conservative over PA.

3. *Compositional Truth Predicate with Δ_0 Induction.* This talk discusses the issue of the arithmetical strength of the truth theory with Δ_0 induction only.

4. *Formalizing Yablo's Paradox.* In the last part we report the results concerning the formalization of Yablo's paradox in known axiomatic truth theories. We describe the properties of Yablo sentences in supervaluational models and in fixed point models with the strong and the weak Kleene schema.

1 The Innocence of Truth

The deflationists claim that the notion of truth is innocent or "metaphysically thin". Various explications of this position have been proposed in the literature. One of them (due to L. Horsten, S. Shapiro, and J. Ketland), is that an adequate theory of truth for a given language conservatively extends a base theory of syntax for this language. The proposal has been debated quite extensively in recent literature. In particular, two interpretations of the phrase "conservatively extends" have been proposed: a syntactic and a semantic one, each contending for the status of a demand to be imposed on a satisfactory (deflationary) theory of truth. A conservative extension in the syntactic sense sense does not prove new theorems of the base language. On the other hand, the semantic conservativity requires the possibility of expanding an arbitrary model of the base theory to a model of the given theory of truth.

The two notions of conservativeness do not coincide. Semantic conservativeness is a more general notion: it gives via completeness theorem the syntactic version, but the opposite implication does not hold. Various examples of truth theories being syntactically, but not semantically conservative over their base theories will be given in the talk.

We are going to consider how exactly conservativity is related to deflationism. Our aim is to investigate the question whether attributing conservativity claims to deflationists was legitimate in the first place: accordingly, we will discuss why conservativity is important and in what sense - if any - conservativity claims form a part of the deflationary doctrines.

2 Models of Weak Theories of Truth

This part treats on *weak* theories of truth. We call a theory **weak** iff it is a conservative extension of PA. Such theories have been introduced to explicate the deflationary claim that by saying "ϕ is true" we do not ascribe any actual property to the sentence ϕ. It is well known that theories with very different axioms for the truth predicate can be conservative over PA. The following definitions introduce the most important ones.

Definition 1. *$\mathcal{L}_{PA}$ denotes the language of arithmetic.*

1. $TB = PA \cup Ind(T) \cup \{\phi \equiv T\ulcorner\phi\urcorner \mid \phi$ *is a sentence of* $\mathcal{L}_{PA}\}$.
2. $UTB = PA \cup Ind(T) \cup$ $\{\forall \bar{s} \left(\phi(\bar{s}^\circ) \equiv T\ulcorner\phi(\bar{s})\urcorner\right) : \phi(\bar{x})$ *is a formula of* $\mathcal{L}_{PA}$ *with free variables* $\bar{x}\}$.

Here $Ind(T)$ stands for the set of all instantiations of induction scheme by the formulae of extended language.

Definition 2. *CT^- is a theory obtained by adding to PA the following axioms for truth predicate $T(x)$*

1. $\forall s, t\ \ T\ulcorner s = t\urcorner \equiv (s^\circ = t^\circ)$
2. $\forall \phi, \psi\ \ T\ulcorner\phi \odot \psi\urcorner \equiv (T\ulcorner\phi\urcorner \odot T\ulcorner\psi\urcorner)$
3. $\forall \phi\ \ T\ulcorner Qx\ \phi(x)\urcorner \equiv (Qt\ T\ulcorner\phi(t)\urcorner)$
4. $\forall \phi\ \ T\ulcorner\neg\phi\urcorner \equiv (\neg T\ulcorner\phi\urcorner)$,
   where $\odot \in \{\wedge, \vee\}$, *and* $Q \in \{\forall, \exists\}$.

Note that in the above definition we do not require that induction scheme is satisfied anymore. In our work, we investigated whether there is a more fine-grained notion of the strength of a theory that would enable us to distinguish various weak theories of truth. We come with the following proposal:

For a theory Th extending PA let $\mathfrak{Th}$ denote the class of models M of PA which have an expansion to a model (M, T) of Th. We say that Th is **not weaker than** Th' iff $\mathfrak{Th} \subseteq \mathfrak{Th}'$.

Now combining some well known facts and our novel results we get that this relation linearly orders main weak theories of truth. More precisely:

Theorem 3. *For a truth theory Th let $\mathfrak{Th}$ be defined as above. Moreover, let $\mathfrak{RS}$ denote the class of recursively saturated models of PA. Then we have the following inclusions:*

$$\mathfrak{PA} \supsetneq \mathfrak{TB} \supsetneq \mathfrak{RS} \supsetneq \mathfrak{UTB} \supseteq \mathfrak{CT}^-.$$

We note that the above answers negatively the question raised by Fujimoto in [4], whether the UTB truth predicate is definable in TB.

3 Compositional Truth Predicate with Δ_0 Induction

By the classical result of Kotlarski, Krajewski and Lachlan ([5]), the compositional theory of truth CT^- is conservative over PA. Since this theory of truth seems to formalise a great deal of the intuitive notion of truth, a natural task arises to establish which principles governing the notion of truth are responsible for non-conservativity results.

An obvious example of a nonconservative theory of truth is the theory CT in which one can prove e.g. global reflection principle for PA, i.e. the following sentence:

$$\forall x\ \text{Form}(x) \wedge \text{Pr}(x) \longrightarrow T(x),$$

where Pr is a predicate representing provability in PA. However, one can immediately show that the full induction is actually much more than needed to obtain this result. In a paper [6] by Kotlarski a proof has been presented showing that CT^- enriched with induction for Δ_0-formulae containing the truth predicate (henceforth abbreviated CT_0) also proves global reflection over PA and thus is not conservative. Unfortunately, Albert Visser pointed out that Kotlarski's proof contained a major gap. Since then, conservativity of CT_0 over PA has been considered an open problem. By that time the erroneous proof was repeated in several places in literature with even stronger claim that the theory CT^-+ "all instances of the induction scheme are true" proves the global reflection principle.

In our talk we would like to present a proof of the following result, giving solution to the problem of conservativity of CT_0 over PA:

Theorem 4. *There exists a formula $T'(x)$ such that provably in CT_0 the formula satisfies axioms of CT^- along with global reflection principle.*

This together with results of Cieśliński from [2] yields the following characterization results for truth theories:

Theorem 5. *The following theories share arithmetical consequences:*

1. CT_0.
2. $CT^- + \forall x\ \text{Form}(x) \wedge \text{Pr}(x) \longrightarrow T(x)$.
3. CT^- + *If* $\ulcorner\phi\urcorner$ *is deducible in propositional calculus from a set X of premises such that* $T(\ulcorner\psi\urcorner)$ *for all* $\ulcorner\psi\urcorner \in X$, *then* $T(\ulcorner\phi\urcorner)$.

4 Formalizing Yablo's Paradox

We present the known metalogical properties of Yablo sentences in different axiomatic truth theories and we describe the properties of Yablo sentences in supervaluational models and also in fixed point models with the strong and the weak Kleene evaluation schema.

Yablo sequence is an infinite sequence of sentences $(Y_n)_{n\in\omega}$, where $Y_n = \forall k > n \neg Tr(Y_k)$ We have here an infinite, noncircular (and with no loops) sequence of non-self-referential sentences. It is easy to observe, that none of the sentences in the list can be true nor false.

We say that $Y(x)$ is a **Yablo formula** in a theory T iff it satisfies the *Yablo condition*, i.e.: $T \vdash \forall x(Y(x) \equiv \forall w > x \neg Tr(\ulcorner \overline{Y(\dot{w})} \urcorner))$ and φ is a **Yablo sentence** in a theory T iff it is obtained by substituting a numeral for x in Yablo formula $Y(x)$.

The results on the topic of Yablo paradox in axiomatic truth theories here are all due to C. Cieślinski [1].

We show that all Yablo sentences are provably equivalent in FS^-.

Theorem 6. $FS^- \vdash \forall x \forall w(Y(x) \equiv Y(w))$

Corollary 1. $FS^- \vdash \forall x \forall w(Tr(Y(x)) \equiv Tr(Y(w)))$ *and* $FS^- \vdash \forall x(Y(x) \equiv \neg Tr(Y(x)))$.

So, provably in FS^-, all (uniform general statement) Yablo sentences are liars. Morevoer we have:

Fact 1. *If FS is consistent, then $FS \nvdash \exists x\, Y(x)$ and $FS \nvdash \exists x\, \neg Y(x)$*

Theorem 7. *Let $Y(x)$ be a Yablo formula provably in $KF + COMPL$. Then: $KF + COMPL \vdash \forall x \neg Y(x)$. Let $Y'(x)$ be a Yablo formula in KF. Then $KF + CONS \vdash \forall x Y'(x)$ and $KF + CONS \vdash \forall x \neg Tr(Y'(x))$.*

Theorem 8. *For every natural number n there exist formulae $Y_0(x)$ and $Y_1(x)$, such that $Y_0(x)$ and $Y_1(x)$ are Yablo formulae in $KF + CONS$ and $KF + CONS \vdash Y_0(n)$ and $KF + CONS \vdash \neg Y_1(n)$*

Corollary 2. *Let $Y(x)$ be a Yablo formula in KF. Then $KF + CONS \vdash \forall x\ (Y(x) \equiv \neg Tr(Y(x)))$*

We also have that KF itself does not decide any Yablo sentence:

Corollary 3. *Let $Y(x)$ be a Yablo formula in KF. Then $KF \nvdash \exists x Y(x)$ and $KF \nvdash \exists x \neg Y(x)$.*

We further show that for any partial fixed-point model and for the Strong Kleene, Weak Kleene and Supervaluation valuation schema, all Yablo sentences $Y(n)$ are neither true nor false under these schema or as to put it: the truth-value of all Yablo sentences $Y(n)$ in fixed-point partial models under any of the above valuation scheme, is indeterminate.

We will be working with a model $(\mathcal{M}, \mathcal{E}, \mathcal{A})$ such that it is a fixed-point model in the meaning of the Kripke's theory of truth. Three-valued logic is a system in which there are three truth values indicating **true**, **false** and an intermediate value - for our purposes this indeterminate third value may be interpreted simply as **unknown**.

In Weak Kleene logic the third truth-value **unknown** is to be read as *meaningless*.

Theorem 9. *For each Yablo sentence $Y(n)$ it holds that: $(|\mathcal{M}|, \mathcal{E}, \mathcal{A}) \not\models_{WK} Y(n)$ and $(|\mathcal{M}|, \mathcal{E}, \mathcal{A}) \not\models_{WK} \neg Y(n)$*

Kleene's strong logic devoted to Kripke's theory of truth, is a logic of indeterminacy. Its intended interpretation is that some sentences are *underdetermined*.

Theorem 10. *For each Yablo sentence $Y(n)$ it holds that: $(|\mathcal{M}|, \mathcal{E}, \mathcal{A}) \not\models_{SK} Y(n)$ and $(|\mathcal{M}|, \mathcal{E}, \mathcal{A}) \not\models_{SK} \neg Y(n)$.*

Supervaluationism is a semantics that was originally invented for dealing with irreferential singular terms and vagueness. According to it, some sentences lack truth-value and are imprecise. However, they may be precisified by an interpretation in a way *extending* the original one. A sentence is supervaluation-true if it is true under all precisifications. In the so-called supervaluation approach to partial models we say that sentence φ is regarded as supervaluation-true in a partial model if φ comes out true in every way of extending this partial model to a total, classical model.

Theorem 11. *For each Yablo sentence $Y(n)$ it holds that: $(|\mathcal{M}|, \mathcal{E}, \mathcal{A}) \not\models_{SV} Y(n)$ and $(|\mathcal{M}|, \mathcal{E}, \mathcal{A}) \not\models_{SV} \neg Y(n)$.*

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CONTRIBUTED ABSTRACTS

A1 LOGIC

A1.1 MATHEMATICAL LOGIC

Thursday, August 6 • 11:00–13:00

Main Building, Room 16

On Implicational Connectives of Quantum Logics for Non-commutative Substructural Logics formulated Gentzen-style Natural Deduction

Ueno Takeshi

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Birkhoff and von Neumann[1] introduced Quantum Logic, in which the commonly agreed definition of the implicational connective has not obtained. Kotas[2] proposed six formulations to define six implicational connectives (Table1, $\supset_0 \sim \supset_5$). Ozawa[4] introduced symmetrical relations among these implicational connectives (Table2). We will investigate these implicational connectives by using **NFL**.

NFL is the Gentzen-style natural deduction for non-commutative substructural logic, which excludes three structural inference rules, i.e. contraction, weakening and exchange (Table3). In our previous papers ([3], [5], [6], [7]), we characterized three structural inference rules in natural deduction. **NFL** is equivalent to the sequent calculus **FL** (full Lambek), the basic sequent calculus for all substructural logics in sequential form.

We will construct proof figures of **NFL**, augmented with other inference rules (Table4), to establish relations among the implicational connectives, so that the relevancies of inference rules, including sturactural rules such as exchange rule, are clarified in detail as folleows:

It holds that: $A \supset_0 B$ is proved from $A \supset_5 B$ in **NFL**, $A \supset_i B$ is proved from $A \supset_5 B$ in **NFL**$(i = 1, 2, 3, 4)$, $A \supset_0 B$ is proved from $A \supset_j B$ in **NFL**$(i = 1, 2, 3, 4)$.

On the other hand, $A \supset_5 B$ is proved from $A \supset_0 B$ in **NFL**$+\{\supset I^0, \supset' I^0, \mathrm{EM}\}$,
$A \supset_k B$ is proved from $A \supset_0 B$ in **NFL**$+\{\supset I^0, \supset' I^0, \mathrm{EM}\}$ $(k = 1, 2, 3)$,
$A \supset_5 B$ is proved from $A \supset_l B$ in **NFL**$+\{\supset I^0, \supset' I^0, \mathrm{EM}\}$ $(l = 3, 4)$,
$A \supset_4 B$ is proved from $A \supset_0 B$ in **NFL**$+\{\supset I^0, \supset' I^0, \mathrm{EM}, \supset' I^{\circlearrowleft}\}$,
$A \supset_5 B$ is proved from $A \supset_1 B$ in **NFL**$+\{\supset I^0, \supset' I^0, \perp, \supset I^2, \neg' E, \supset I^{\circlearrowleft}\}$,
$A \supset_5 B$ is proved from $A \supset_2 B$ in **NFL**$+\{\supset I^0, \supset' I^0, \perp, \supset I^2, \neg E\}$.

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Table 1: Implicational connectives of quantum logics

$$
\begin{array}{lll}
A \supset_0 B & \iff & \neg A \vee B \ \ : \textit{classical logic} \\
A \supset_1 B & \iff & (A \wedge (\neg A \vee B)) \vee (\neg A \wedge B) \vee (\neg A \wedge \neg B) \\
A \supset_2 B & \iff & (A \wedge B) \vee (\neg A \wedge B) \vee ((\neg A \vee B) \wedge \neg B) \\
A \supset_3 B & \iff & \neg A \vee (A \wedge B) \ \ : \textit{Sasaki arrow} \\
A \supset_4 B & \iff & (\neg A \wedge \neg B) \vee B \\
A \supset_5 B & \iff & (A \wedge B) \vee (\neg A \wedge B) \vee (\neg A \wedge \neg B)
\end{array}
$$

Table 2: Relation of implication

$$
\begin{array}{lll}
A \supset_0 B & \iff & (A \supset_5 B) \vee \neg \underline{\vee}(A,\ B) \\
A \supset_1 B & \iff & (A \supset_5 B) \vee (A \wedge \neg \underline{\vee}(A,\ B)) \\
A \supset_2 B & \iff & (A \supset_5 B) \vee (\neg B \wedge \neg \underline{\vee}(A,\ B)) \\
A \supset_3 B & \iff & (A \supset_5 B) \vee (\neg A \wedge \neg \underline{\vee}(A,\ B)) \\
A \supset_4 B & \iff & (A \supset_5 B) \vee (B \wedge \neg \underline{\vee}(A,\ B))
\end{array}
$$

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A theory for systems of propositions referring to each other

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As well-known, all classical paradoxes involve a kind of self-reference. A paradox without any self-reference was proposed by Yablo twenty years ago in [1] (for a subsequent discussion see [2]–[6]). This new paradox can be considered as an unfolding of the paradigmatic Liar Paradox: it consists of propositions indexed by natural numbers such that each of the propositions states "all propositions with greater indices are wrong". Our purpose is to investigate arbitrary systems of propositions some of which state that some others are wrong, and to learn which of these systems are paradoxical and which are not. For this, we introduce a first-order theory of a language with one unary and one binary predicates, T and U. Heuristically, variables mean propositions, Tx means "x is true", and Uxy means "x states that y is wrong". As we show, the theory is Π^0_2 but not Σ^0_2. We study which model-theoretic operations preserve or do not preserve the theory, and provide a natural classification of its models. Furthermore, we say that a model (X, U) is non-paradoxical iff it can be enriched to some model (X, T, U) of this theory, and paradoxical otherwise. E.g. a model of the Liar Paradox consists of one reflexive point, a model of the Yablo Paradox is isomorphic to natural numbers with their usual ordering, and both are paradoxical. Generalizing these two instances, we note that any model with a transitive U without maximal elements is paradoxical. On the other hand, any model with a well-founded U^{-1} is not. We also examine other classes of relations, show that the paradoxicality (and hence non-paradoxicality) is a Δ^1_1 but not elementary property, and provide a classification of non-paradoxical models.

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Logic and philosophy of trial and error mathematics: Dialectical and quasi-dialectical systems

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Formal systems represent mathematical theories in a somewhat static way, in which axioms of the represented theory have to be defined from the beginning, and no further modification is permitted. As is clear, this representation is not comprehensive of all aspects of real mathematical theories. In particular, these latter – as often argued, starting from the seminal work of Lakatos (see [3]) – are frequently the outcome of a much more dynamic process than the one captured by formal systems. For instance, in defining a new theory, axioms can be chosen through a trial and error process, instead of being initially selected. Dialectical systems, introduced by Roberto Magari in [4], are apt to characterize this dynamic feature of mathematical theories (see [2] for a similar, yet non equivalent, characterization). In this paper, we prove several results concerning dialectical systems and of the sets that they represent, called dialectical sets. In particular, we offer a degree theoretic characterization of dialectical sets. We prove that all dialectical sets are Turing equivalent to some computably enumerable set. Then, in order to better analyze the intended semantic of dialectical systems, we introduce a more general class of systems, that of quasi-dialectical systems. These are systems that naturally embeds a certain notion of "revision". We prove that quasi-dialectical sets lie in the same Turing-degrees of dialectical sets, hence showing that they display the same computational power. Nonetheless, we conclude by proving that quasi-dialectical sets and dialectical sets are different, and by showing their respective place in the Ershov hierarchy (see [1]).

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Some general results on the translations between logics and theories

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In the late twenties and early thirties of last century several results were obtained connecting different logics and theories. These results assumed the form of translations/interpretations of one logic/theory into another logic/theory. A minimum requirement is that they preserve deducibility: Given two logics L1 and L2 and a translation T of L2 into L1, then S |-L2 A if and only if T[S] |-L1 T[A]. The aim of the present paper is to show the following results concerning translation between logics and theories:

[1] Given two logics L1 and L2 and a translation of L2 into L1, then, given any intermediate logic L3 between L1 and L2, the same translation can be used to translate L2 into L3. It is also shown that this translation cannot be used to translate L3 into L1.

[2] In 1979, R. Statman showed a translation from Intuitionistic Propositional Logic into its implicational fragment. This reduction is polynomial and proves that Purely Implicational Minimal Logic is PSPACE-complete. The methods that Statman used are based on proof-theory. The sub-formula principle for a Propositional Natural Deduction system NL for a logic L states that whenever α is provable from Γ in L, there is a derivation of α from a set of assumptions {δ1, . . . ,δk} ? Γ built up only with sub-formulas of α and/or {δ1, . . . , δk}. We show that any propositional logic L with a Natural Deduction system that satisfies the sub-formula principle has a translation into purely minimal implicational logic.

[3] The third result establishes that if T is a first order theory formulated in the language {~,&, →, ∀} and T is atomically stable, then every theorem of T can be proved without the use of classical reasoning.

A1.2 MATHEMATICAL LOGIC

Thursday, August 6 • 14:30–16:30
Main Building, Room 16

On Gödel numbering

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In many literature Gödel numbering is an important machinery for proving that Peano Arithmetic (P.A. for short) is incomplete. The machinery of Gödel numbering, assigning syntactical entities to natural numbers, aims to enable arithmetic sentences to indirectly talk about syntactical entities while directly talking about natural numbers.

Arithmetic sentences, with the machinery of Gödel numbering, can be interpreted as talking about syntactic entities, including arithmetic sentences themselves. And we can obtain an arithmetic sentence that says that it itself is not provable, such sentence is really neither provable nor refutable, and hence undecidable in P.A.

It is not clear that if we would get a different undecidable sentence with different kind of Gödel numbering. And at the same time, the undecidability of arithmetic sentences is, in principle, independent of the choice of Gödel numbering. More straightforwardly, once the axioms of P.A. are set, undecidable sentences would immediately be set as well.

In this paper I will investigate the relation between axioms of P.A. and undecidable sentences in P.A. And I will also investigate about whether we will obtain a different undecidable sentence with different machinery of Gödel numbering in the final course of proving the incompleteness of P.A. I will also study the possibility of proving Gödel's incompleteness theorem without recourse to Gödel numbering since the undecidability of arithmetic sentences is, in principle, independent of our choice of Gödel numbering.

On the problem of preserving finite axiomatizability of a finite matrix under term-equivalence

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We shall present two related open problems noticed by Wolfgang Rautenberg, namely the question of whether or not the consequence operation of a finite matrix is finitely based and whether or not finite axiomatizability of a finite matrix is preserved under term-equivalence. The partial solutions to these problems were proposed by Rautenberg, Palasinska, Wronski et al.

Herrmann and Rautengerg proved that every 2-element matrix is finitely based regardless its term-equivalence classification, similarly every 2-valued matrix is finitely axiomatizable. The example of a 3-element matrix with a nonfinitely based consequence operator is due to Wronski, while Palasinska has shown that no matrix term- equivalent to Wronski's example is finitely based.

We shall briefly characterize the notion of term-equivalence and finite axiomatizability relatively to a fixed set of rules. Then we shall present some problems and results concerning finite axiomatization of small matrices, e.g. the observation credited to Mordechaj Wajsberg that there are infinitely many finite matrices not finitely axiomatizable relatively to Modus Ponens rule.

Do infinitely often equal trees add Cohen reals?

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Laguzzi Giorgio
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An real x in the Baire space is called "infinitely often equal (ioe)" if for every y in the ground model, x and y agree on infinitely many coordinates. We analysed the sigma-ideal I_ioe naturally related to ioe reals, in the sense that forcing with Borel I_ioe-positive sets canonically adjoins them. Does such

a forcing add Cohen reals? By unpublished work of Goldstern and Shelah, we know that some conditions do; but it is open whether all conditions do. I will present some results that could provide an answer. If there are conditions forcing that no Cohen reals are added, then this would provide an alternative solution to Fremlin's problem "can we add ioe reals without adding Cohen reals", recently solved by Zapletal.

A1.3 MATHEMATICAL LOGIC

Friday, August 7 • 11:00–13:00
Main Building, Room 17

Extending the set of variables in propositional logics

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Cintula Petr
Theoretical Computer Science, Institute of Computer Science, Prague, CZECH REPUBLIC

Abstract algebraic logic is the branch of mathematical logic that provides a systematic framework to deal with the multiplicity of logical systems according to their relation with corresponding algebraic semantics.

Some of its main results are those labeled as transfer theorems, which can be described as theorems that show that a property of the lattice of theories of a given logic also holds for the lattice of logical filters over an arbitrary algebra. Czelakowski in his monograph published in 2001 proved a general transfer principle encompassing a majority of such results.

The proofs of transfer results, including the general transfer principle of Czelakowski, can be rather involved and often require to add new variables to the language of the logic which, roughly speaking, give a syntactical means to refer in the logic to the elements of an arbitrary algebra. In those proofs it is usually important to make sure that the logic obtained in the extended language does not differ too much from the original one.

This is made precise in by the notion of natural extension. The proof of the mentioned general transfer principle (and some other results) require the existence of natural extensions of a given logic for arbitrary new sets of variables. A syntactical definition of a candidate of such extension was given by Shoesmith and Smiley and was claimed to work in general by Czelakowski in an exercise of his book.

We present an example showing that this construction actually does not work in full generality and identify a technical restriction (satisfied by a vast majority of natural logical systems, including all finitary ones and those with a countable language) that needs to be added to ensure the existence of natural extensions.

The Librationist Domination of Second Order Arithmetic

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(Bjørdal 2012) gives an account of the semantics for the librationist system £ which gives a novel approach to the semantical and set theoretical paradoxes, and (Bjørdal 2014) makes many matters more meticulous. (Bjørdal 2012) shows that £ accounts for a system of transfinitely iterated inductive definitions + Bar Induction which has a proof theoretical ordinal beyond the strongest of the Big Five of the Reverse Mathematics program. (Bjørdal 2014) shows that £ + The Skolem Cannon + The Fraenkel Postulate gives an interpretation of ZFC if ZFC is consistent; this is by extending an interpretation of ZF by Friedman (1973) in a system S which is ZF minus extensionality with collection and weak power. We here show that £ + The Skolem Cannon (the latter states that separation with first order conditions on kind - i.e. nonparadoxical - sets preserves kindness) interprets higher order arithmetics and Zermelo set theory . This involves the invocation of a novel set operation called "domination" which unlike the power set operation is not a paradoxical one according to £ (see (Bjørdal 2012) for more on this) and which is based upon a peculiar fixed point operation we call manifestation point which was clarified by Andreas Cantini and has semantical roots in work by Albert Visser and, ultimately, Kleene, Carnap and Gödel.

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Residuated lattices with Galois connections as monadic operators

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We consider residuated lattices with Galois connections as monadic operators and prove their characterization theorem, that is, for a residuated lattice X, $(X, \exists, \forall)$ is a monadic residuated lattice, which is defined by J. Rachůnek and D. Šalounova in 2013, if and only if there exists an m-relatively complete subalgebra X_0 of X. We also show a characterization of m-filter.

Keywords: monadic residuated lattice, Galois connection, m-filter

A Constructive Justification of Brouwer's Bar Induction

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Brouwer introduced a key principle called the bar induction in order to develop his intuitionistic analysis:

Bar Induction (BI): Assume that

A1 $\forall\alpha\exists x(\overline{\alpha}(x) \in B)$,

A2 $\forall n\forall y(n \in B \to n * \langle y\rangle \in B)$,

A3 $\forall n(n \in B \to n \in P)$,

A4 $\forall n(\forall y(n * \langle y\rangle \in P) \to n \in P)$.

Then $\langle\rangle \in P$.

We remark that another important theorem called the fan theorem is derived from *BI*. Brouwer aimed to give a constructive justification of *BI* ([Brouwer27]). Suppose that the assumption A1 is given. Here he considers the form that would be taken by a canonical proof of A1. Under the conditions A2-A4, we can transform any possible (canonical) proof of A1 into another proofs of the conclusion. Brouwer supposed a *controversial assumption* saying that such any canonical proof contains only few elementary inference rules.

In this talk, we propose a novel approach to a justification of *BI* via a tool called the Ω-rule in infinitary proof theory. We claim that our analysis is constructive because this method is based on a constructive reading of implication. Moreover, according to our proposal, Brouwer's assumption is a quite natural mathematical restriction on the form of canonical proofs for the quantification over proofs to work.

First, we introduce an infinitary system $ELBI^\Omega$ with a version of the Ω-rule. Let $ELBI_0^\Omega$ be an infinitary version of Elementary Analysis (*EL*). This system has Schütte's ω-rule and infinitary lambda terms to represent choice sequences. $ELBI^\Omega$ is defined by adding the following B^Ω-rule to $ELBI_0^\Omega$:

Definition.

$$(B^\Omega)\ \dfrac{\begin{array}{c}\{q : \forall f\exists x B(f,x)\}\\ \vdots\\ \ldots A\ldots\end{array}}{\forall f\exists x B(f,x)) \to A}$$

where q is an arithmetical normal (closed) proof of $\forall f\exists x B(f,x)$.

Then we prove the main theorem:

Theorem. *$ELBI \ni d : \Gamma \vdash A \Rightarrow ELBI^\Omega \ni d^\infty : \Gamma' \vdash A'$ for any closed instance A' of A.*

By inspecting the proof, we see that this embedding argument is a quite close or essentially the same as Brouwer's argument for *BI*. If time is permitting, we also discuss about our meta-theory and more proof-theoretic results like the normalization and the collapsing (impredicative cut-elimination) theorems and their applications.

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A1.4 MATHEMATICAL LOGIC

Tuesday, August 4 • 17:00–19:00
Main Building, Room 17

Combining relational and algebraic semantics

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Logical investigation is usually divided into two fields: syntax and semantics. A "logic" can be determined by a syntactic calculus or/and by some class of semantic structures. Various completeness results can be understood as bridges between these two areas. On the syntactic side, there are different types of calculi such as Hilbert style calculi, Natural deduction systems, and Sequent calculi. The situation is similar on the semantic side. There are also different semantic frameworks among the most prominent of which are algebraic semantics and relational semantics. The aim of this paper is to combine these two frameworks into a new one and show some properties of this synthesis.

The proposed semantics is akin to relational semantics in the sense that it is based on a recursively defined relation between the elements of a given structure on one side and formulas on the other side. This relation strongly resembles the relation of truth of standard relational semantics. However, the semantics is also closely related to algebraic semantics since the structures in question are algebraic structures typically used in algebraic semantics.

The proposed semantics has an epistemic interpretation. The algebraic structures are interpreted as structures of information sates (where, e.g., the join of the states a and b represents the body of information that is common to a and b). The relation between states and formulas is interpreted as an assertibility relation.

We start with arbitrary bounded lattices and show that intuitionistic logic is the logic of all bounded distributive lattices. In fact, in our semantics it is also the logic of all Boolean algebras even though the logic of finite Boolean algebras is classical logic.

If the time allows, we will show that this framework can be used also as a new semantic framework for modal logic.

The modal logic of symmetric forcing

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Symmetric forcing was first used by Paul Cohen to show the independence of the Axiom of Choice from ZF. It is a modification of the method of forcing, a flexible set theoretic model construction assigning to a given (countable transitive) model of ZF outer models, called generic extensions, each of which is "generated" from a single new object. The forcing method itself is unsuitable for establishing the independence of the Axiom of Choice from ZF, since every generic extension of a ZFC-model also satisfies the Axiom of Choice.

So instead Cohen used symmetric forcing, considering symmetric submodels of generic extensions instead of actual generic extensions. Symmetric submodels are obtained by deleting objects whose descriptions (in terms of the so-called forcing language) are not sufficiently stable under a certain group action. This process may remove well-orderings of sets still present, thereby breaking the axiom of choice.

We refer to symmetric submodels of generic extensions in short as symmetric extensions. A central property of symmetric extensions (and generic extensions as well) is that truth in them can be expressed in the ground model one starts with. More precisely for every first-order sentence φ in the language of set theory there is a first-order sentence φ* in the language of set theory such that for any (countable transitive) ZF-model M we have that M⊨φ* iff for any symmetric extension N of M: N satisfies φ.

Using this fact we can give a correspondence between formulas in the basic modal language and first-order sentences in the language of set theory as follows. A translation is a map assigning proposition letters to sentences in the language of set theory. We can extend any translation T to an interpretation T' assigning formulas in the basic modal language to first-order sentences in the language of set theory by recursively setting:

(1) T'(p):? T(p) for any proposition letter p;
(2) T'(⊥):? (0?1);
(3) T'(A+B):? T'(A)+T'(B) for any logical connective +;
(4) T'(?A):? [T'(A)]*

With this we can define the ZF-provable modal logic MLS of symmetric forcing by setting MLS:?{A | ZF proves T'(A) for any translation T}

This definition is analogous to the definitions of the corresponding modal logic of forcing as introduced and investigated by Joel Hamkins and Benedikt Löwe in [1]. Using an adaptation of their methods we show that MLS ? S4.2 and therefore that MLS coincides with the modal logic of forcing.

References:1. JOEL D. HAMKINS, BENEDIKT LÖWE, The modal logic of forcing. Transactions of the American Mathematical Society, vol. 360 (2008), no. 4, pp. 1793-1817

Quantified intuitionistic and modal logic over metrizable spaces

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In the early 40s, McKinsey and Tarski developed topological semantics for intuitionistic logic, H, and the modal logic, S4, proving that H and S4 are complete not only for the class of all topological spaces, but also for some particular topological spaces: notably any separable dense-in-itself metric space, such as the real line, $\mathbb{R}$, the irrational line, $\mathbb{P}$, and the rational line, $\mathbb{Q}$. This semantics was extended to the quantified intuitionistic [modal] logic QH [QS4] in the late 40s and early 50s, notably by Rasiowa and Sikorski. They proved the completeness of QH [QS4] for the class of all topological spaces, with constant domains for the quantifiers. As for particular topological spaces, they constructed a subspace of $\mathbb{P}$ for which QH [QS4] is complete with a constant countable domain. On the negative side, they showed that QS4 is not complete for any Baire space with a constant countable domain.

Subsequent work has improved surprisingly little on these results. Dragalin (1979) showed that QH is strongly complete for $\mathbb{P}$, with a constant countable domain. And Kremer (2014) showed that QS4, and consequently QH, is strongly complete for $\mathbb{Q}$, with a constant countable domain – but not strongly complete for $\mathbb{R}$, with a constant domain of any size.

This talk will introduce the semantics together with these results, as well as some new unpublished results for QH. The first new result substantially generalizes the above-mentioned results for $\mathbb{P}$ and $\mathbb{Q}$: QH is strongly complete for *any* zero-dimensional dense-in-itself metrizable space with constant domain; indeed for any *separable* zero-dimensional dense-in-itself metrizable space, with a constant *countable* domain. The second new result is that, if we allow varying rather than constant domains for the quantifiers, then QH is strongly complete for any dense-in-itself metrizable space with constant countable domain. Analogous questions for QS4 remain open.

A2

A2.1 PHILOSOPHICAL LOGIC

Tuesday, August 4 • 11:00–13:00
Main Building, Room 8

Deflationism and Conservativity

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Deflationism about truth on the one hand, and axiomatic theories of truth on the other, have both recently taken a central role in the philosophical and logical discussion about the role and nature of truth. In this paper I will look at the intersection of these two recent programs: axiomatic, deflationary theories of truth. In particular I will be arguing that axiomatic theories of truth need not be conservative over first-order, mathematical base theories like PA to be considered deflationary in a meaningful sense. The problem arises because, if truth is metaphysically insubstantial as deflationists would have it, it looks as though adding truth to a truth-free theory should not have any new, truth-free consequences for the base theory. This gives rise to a much larger problem for the deflationist: given that theories which are conservative over PA, such as the theory of uniform Tarski biconditionals (UTB), are weak and do not meet other intuitive criteria (e.g. generalisation), insisting on conservativity is tantamount to rejecting deflationism. I will present three arguments against the conservativity requirement which jointly provide a solution for deflationists. The first is that, as we move to stronger base theories, stronger theories of truth will be provably conservative. For example, UTB is not conservative over classical first-order logic, but, as was recently shown, some theories of truth are conservative over ZF that are not conservative over PA. The second argument is that other criteria, like generalisation, compositionality, non-ad hocness, etc., are more central to truth than conservativity. Finally, I will argue that, if we want mathematical truth to coincide with truth simpliciter, then it is extremely unlikely that a conservativity requirement will be meaningful, as we would need some idea of what a 'truth-free theorem of English' would be.

Deflationism and the meaning of Gödel's sentence

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Difficulty with which the deflationary theory of truth meets in the case of nonconservativity of theory's extension (for example, PA), arising in case of addition to the initial theory of the truth- predicate, is the strongest argument against the deflationary theory of truth. S. Shapiro shows possibility to deduce in the case of addition of the truth-predicate to PA, for example, Gödel's sentence, that is impossible without it. This fact is interpreted as the certificate in favor of substantiality of the truth concept.

Without insisting on correctness of deflationary theory, it seems to us, that the argument of nonconservativity on the basis of getting Gödel's sentences with adding a truth-predicat needs essential addition. The Gödel's sentence is of a very specific nature. Therefore before directly claiming about an inaccuracy of the deflationary theory, we must consider a question of meaning of the Gödel's sentence and a question about how we understand its validity. For example, M. Dammit interprets Gödel's sentence not as universal sentence of metamathematics, but as usual universal sentence of arithmetic. Similar approach was used by N. Tennant for 'show that the deflationist has at his disposal' methods to prove Gödel's sentence (in some extended theory) of without making use of a truth-predicate. This approach assumes a priority of our knowledge of the truth of the totality of its numerical instances before the truth of the sentence itself, that can be challenged. The meaning of Gödel's sentences directly depends on a way of its constructing. Only by tightly constraining the means of construction can one obtain Gödel's sentences of which it is correct, without further ado, to say that they say of themselves that they are unprovable and that they are true. It means that we can't approve an inaccuracy of deflationism on the basis of nonconservative extension of the theory (getting Gödel's sentence in PA with truth- predicat) without analysis of a way of Gödel's sentence's constructing. Different way of its constructing may involves concept of truth in different sense, for example, without appealing to semantic interpretation of truth, and that will be compatible with deflationist's position.

Motivations for alethic pluralism

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Alethic pluralism holds that there are distinct, domain-specific truth properties. The motivation for pluralism that has received the most attention is the thought that true propositions about different subject matters are accordingly true in different ways. Thus, for example, scientific truth is correspondence, mathematical truth is coherence, and ethical truth is superwarrant. However, this motivation has not struck many as compelling. Are there other motivations for pluralism?

In this paper, I investigate and evaluate the prospects of alternative kinds of motivations for pluralism. One is the thought that it is the correct response to the semantic and set-theoretic paradoxes. If the correct response to the liar paradox is to grant that there are distinct truth predicates that are somehow domain-specific (as in Tarski's hierarchy of truth predicates), a natural bridging principle between predicates and properties suggests pluralism. Similarly, but less directly, if the correct response to Russell's paradox is to grant that there is no comprehensive domain that contains absolutely everything there is, a principle associating domains with truth predicates suggests pluralism.

Another kind of motivation is the thought that, on plausible assumptions, alethic pluralism follows from logical pluralism, as well as ontological pluralism. If there are distinct logics that are equally legitimate, then there are also distinct kinds of logical truth (and thus truth simpliciter) that are equally legitimate. Similarly, if there are distinct kinds of existence that are equally legitimate, then if propositions have sentence-like structure, propositional truth may vary according to the way in which property instantiation by objects varies. Yet another kind of motivation is the thought that widely-accepted pluralism about modality entails pluralism. If there are distinct kinds of modality (metaphysical, epistemic, etc.), then if M is a kind of modality, then a proposition's M- necessity (truth in all M-possible worlds) entails its M-truth.

On the simplicity of truth

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In the literature it has sometimes been claimed that truth is a simple notion. Since our formal theories of truth are purportedly designed to capture our pre-theoretic conception of truth, it would seem to follow that they also ought to specifically capture this very fact. Surprisingly little has been done to understand the notion of simplicity more precisely on either a philosophical or a formal level, however. And yet the questions of (i) whether truth is simple, and (ii) what this implies for one's truth theory, are arguably important ones. This paper aims to make some initial progress towards answering them. Accordingly, we begin by examining the (scarce) extant attempts to address (i) and (ii) above, ultimately concluding that none of these does justice to the simplicity claim. In its main part, the paper moves to examine a different proposal for how to interpret the simplicity of truth. The suggestion is to look to a different area of philosophy where the notion of simplicity is known to play an important normative role: the debate on theoretical virtues in philosophy of science. While there is still disagreement about exactly how the simplicity of a scientific theory ought to be measured, much more progress has been made in this than in the truth-theoretic context. Discussions of simplicity in philosophy of science can be seen to revolve around three key questions:

1. How should simplicity be measured? 2. What is the justification for regarding simplicity to be a virtue? 3. How is simplicity to be traded-off?

In the remaining part of the paper we apply each of these questions, in turn, to the truth-theoretic case, and discuss some of the (seemingly) more plausible answers to the same. Finally,we draw some reasonably optimistic conclusions from this exercise.

A2.2 PHILOSOPHICAL LOGIC

Tuesday, August 4 • 14:30–16:30
Main Building, Room 8

Truth and Reference in first-order arithmetic

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According to deflationism, the truth predicate would be entirely dispensable save for the fact that it enables us to express certain generalizations or 'infinite conjunctions' ('all theorems of arithmetic are true'). Several deflationists (e.g. Horwich, Field) claim that the truth predicate can serve this function in virtue of its disquotational nature--i.e. every sentence A is equivalent to "'A' is true" (T-schema).

Accordingly, deflationist truth theories must contain all instances of the T-schema to guarantee the expressive function of truth. However, as is well known, the T-schema is inconsistent with many classical systems, such as Peano arithmetic, due to paradoxes like the liar (given by a sentence that says of itself that it's untrue).

While some authors depart from classical logic (Field), others restrict the T-schema as little as possible, to unproblematic instances (Horwich). Discriminating between safe and unsafe instances isn't straightforward. The so far proposed criteria are either too complex (groundedness, stability) or rather ad hoc (positive instances, typing). Adopting complex criteria means that in many cases there's no way to know whether an instance of the T-schema holds or not; they don't provide a truth predicate we could use to make generalizations, as deflationists want.

Usually, paradoxical expressions are said to display certain characteristic reference patterns (self-reference, non-wellfoundedness). Nonetheless, reference patterns for first-order languages have only been investigated from a semantic standpoint, resulting in too complex criteria. I first provide intuitive proof-theoretic notions of reference for such languages, and show them to be consistent and simple enough (Sigma 1) to serve as a restrictive criterion. Secondly, I put forward a definition of unproblematic sentence based on its reference pattern. Finally, I give a consistent theory of truth that obtains by restricting the T-schema to unproblematic expressions, and prove some metatheoretical results.

Towards a Non-Fregean Axiomatic Theory of Truth

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Non-Fregean logics, introduced by R. Suszko, can be seen as a realization of Gottlob Frege's semantic program with the exception of a postulate, known in the literature as *the Fregean axiom*, that treats the truth value of a sentence as its denotation, and is a fundamental assumption underlying classical logic.

Non-Fregean logic was explicitly proposed by Suszko as an alternative to the established standard, as it rejects the Fregean axiom and introduces a universe of the semantic correlates of statements, known as the universe of *situations*. In order to express claims concerning the universe of situations, a new connective $\equiv$, called the *identity connective,* is added to the language. The identity connective expresses the identity of two statements, which is true whenever the semantic correlates of the statements are the same. Suszko presents the central ideas of the non-Fregean framework and the underlying philosophical motivations extensively in his article [SUS75].

One of the most applicable non-Fregean logics is $\mathsf{SCI_Q}$, which is the extension of the minimal non-Fregean propositional logic SCI with quantifiers ranging over propositional variables. The logic $\mathsf{SCI_Q}$ offers a wide repertoire of ways to express interesting properties of the universe of situations. In particular, as shown in the paper [GPH14], Peano arithmetic can be coded in $\mathsf{SCI_Q}$.

In our talk we will present basics of the logic $\mathsf{SCI_Q}$ and give an overview of our first results on the formalization of certain typed and type-free theories of truth with Peano arithmetic as the base theory.

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CONTRIBUTED PAPERS / A2.2 PHILOSOPHICAL LOGIC

Homotopy Model Theory

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"Homotopy Type Theory" connects logic with homotopy theory through type theory. I would like to show that logic can be connected with homotopy theory through model theory.

Given a first-order language L with equality, supposed to contain a unary quantifier Q, let F_n be the set of formulas of L with exactly $v_0, \ldots, v_n$ as free variables. The two following applications $d_i : F_n \to F_{n-1}$ (for $n \geq 1$) and $s_i : F_n \to F_{n+1}$ can then be defined:

$d_i(\phi(v_0, \ldots, v_n)) = Qx\ \phi(v_0, \ldots, v_{i-1}, x, v_i, \ldots, v_{n-1})$
$s_j(\phi(v_0, \ldots, v_n)) = ((v_j = v_{j+1}) \to \phi(v_0, \ldots, v_{j-1}, v_{j+1}, \ldots, v_{n+1}))$.

Up to logical equivalence between formulas (and provided that the quantifier Q satisfies two very mild conditions), these maps satisfy a set of equalities called "simplicial identities." In other words, $F_*^Q = \langle F_n, (d_i^n)_{0\leq i\leq n}, (s_j^n)_{0\leq j\leq n}\rangle_{n\in\mathbb{N}}$ is a *simplicial set*. So Q can be compared to a "face operator," while (s_j) is the corresponding sequence of "degeneracy operators." The *boundary* of a given formula ϕ can then be defined as follows:

$$\partial\phi := \bigwedge_{i=0}^{n-1} \neg^i \forall x \phi(v_0, \ldots, v_{i-1}, x, v_{i+1}, \ldots, v_{n-1}).$$

One can check that $\partial(\partial\phi) \equiv \perp$ for any formula ϕ, which prompts a comparison of ∂ with a boundary operator pointing to homotopy theory.

Let's turn now to the models of some theory T laid down in L, with $Q = \exists$. For such a model M, $M_* = F_*^{\exists,M} = \langle D_n(M), (\exists_i^{n,M})_{0\leq i\leq n}, (s_j^{n,M})_{0\leq j\leq n}\rangle_{n\in\mathbb{N}}$
where $D_n(M)$ (for $n \geq 0$) is the set of all definable subsets of $|M|^{n+1}$,
where $\exists_i^{n,M} : D_n(M) \to D_{n-1}(M)),\ A = \{\vec{a} \in |M|^{n+1} : M \vDash \phi_A(v_0, \ldots, v_n)[\vec{a}]\} \mapsto \{\vec{a'} \in |M|^n : M \vDash \exists x\ \phi_A(v_0, \ldots, v_{i-1}, x, v_i, \ldots, v_{n-1})[\vec{a'}]\}$ are the face operators, and where $s_j^{n,M} : D_n(M) \to D_{n+1}(M),\ A \mapsto \{(\vec{x}, y) : \vec{x} \in A \text{ and } y = x_j\}$ are the degeneracy operators. The resulting M_* is a simplicial complex for any L-structure M.

Theorem 1. *A substructure M of a L-structure N is an elementary substructure of N iff the corresponding restriction $r_* : N_* \to M_*$ is a simplicial map.*

Corollary 1. *The mapping $(-)_*$ is a contravariant functor from the category of L-structures and elementary embeddings, to the category of simplicial sets and simplicial maps.*

Theorem 2. *Let M be an elementary substructure of N. Then M_* is a retract of N_* iff the domain $|M|$ of M is definable in N.*

Other results can be reached which extend these first ones, in particular about spaces of types.

Epistemic Truth-Values

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A number of objections have been addressed by Niiniluoto (2014) against an epistemic definition of truth $\mathrm{T}_a p$, according to which the truth of a proposition p is relative to an epistemic agent a. These objections are the following:

(1) Relative truth fails to satisfy Von Wright's truth-logic;
(2) It entails the omniscience of truth: $\mathrm{T}_a p,\ p \supset q \vdash \mathrm{T}_a q$;
(3) There are no external constraints for truth and falsity;
(4) Tarski T-equivalence cannot be sustained, both because the equivalence scheme $\mathrm{T}_a p \equiv p$ does not make sense and because $\mathrm{B}_a p \vdash p$ and $p \vdash \mathrm{B}_a p$ are not accepted in doxastic logic;
(5) The definition of relative truth leads either to self-refutation or infinite regress.

The aim of the present paper is to reply to (1)-(5) through an alternative characterization of truth-values.

Logic and epistemology are both related to truth, although these areas of philosophy deal with this central concept from different perspectives. Although the common distinction between formal and material truth is meant to avoid any ambiguity between the two disciplines, I want to discuss the reasons why a pragmatist approach to truth questions this usual borderline. For this purpose, I advocate several topics from epistemic logic to the theory of opposition.
My thesis is that the ensuing coherence theory of truth should justify an alternative semantics, thereby revisiting the usual concept of truth-value in logic through a faillibilist defence of truth in epistemology.

The result is a structural theory of meaning and a Boolean algebra of bitstrings, whereby the so-called truth-value of a proposition is replaced by the logical value of a statement. The transition from a fallibilist theory of truth to a non-Fregean theory of logic will serve as a guideline for the whole talk.

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*The research leading to these results has received funding from the Basic Research Program at the National Research University Higher School Economics.

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An assumption-based logic for the analysis of inconsistent premises

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In our talk we present a paraconsistent system based on classical logic. An inspiration comes from the traditional idea in Rescher & Manor (1970) that a necessary condition for being a consequence is to be derivable from a consistent subset of the premises. However, in many applications this criterion is too restrictive because of the resulting syntax-dependency (where different but equivalent formulations of the premise set lead to different conclusions). To overcome this problem our systems are equipped with inference rules that allow for the analysis of the premises. Moreover, unlike traditional systems, consistency assumptions are integrated in a dynamic proof theory. The idea is to protocol significant assumptions about the consistency of formulas that are used in crucial inference steps (such as resolution and aggregation). When these assumptions are violated, the inference gets retracted. This way of integrating consistency assumptions is, for instance, crucial in a predicative setting where no effective test for consistency is available. We will show that depending on what assumptions are protocolled one can obtain either a credulous or skeptical notion of consequence.

We will provide an argumentation-based semantics that is adequate relative to the dynamic proof theory and present meta-theoretic properties of the system. Finally, we compare our logic with similar systems known from the literature such as Quasi-Classical Logic (Besnard & Hunter 2000), the argued consequence (Benferhat et al. 1997), AN(A) (Meheus 2000), CL^- (Batens & Provijn 2001), inconsistency-adaptive logics (Batens 2007), and the argumentation systems based on classical logic by Besnard & Hunter (2009).

At the end of the talk we will indicate how by enhancing the system with a non-classical conditional we obtain an interesting variant of default logic.

A2.3 PHILOSOPHICAL LOGIC

A Lattice of Fundamental Four-Valued Modal Logics

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Two lattices of four-valued modal logics were described in literature. The former of them [1] is constructed via extending four-element Boolean algebra, and the latter [2] – via extending four-element De Morgan lattice. This paper is devoted to combining these two methods.

Let us consider the set of truth-values M = {0, *a, b,* 1} partially ordered in the following way: 0 < a, b < 1. With respect to this order the set M constitutes a Boolean algebra B^2 = B ´ B, where B is a two-element Boolean algebra. The following functions of one argument are used: Boolean negation Ø(*x*), De Morgan negation ~(*x*) and endomorphism *e*(*x*), where Ø0 = 1, Ø*a* = *b*, Ø*b* = *a*, Ø1 = 0; ~0 = 1, ~*a* = *a*, ~*b* = *b*, ~1 = 0; *e*0 = *e*a = 0, *e*b = *e*1 = 1.

Let (f_1, f_2, …, f_k) be a functionally closed class generated by functions f_1, f_2, …, f_k from P_4, where P_4 is the class of all functions of four-valued Post's logic which is functionally complete. If D is a distributive lattice (Ú, Ù), then B^2 = (Ú, Ù, Ø), *DM4* = (Ú, Ù, ~) – four-element De Morgan lattice, *P*1 = (Ú, Ù, Ø, *a*) = (Ú, Ù, Ø, *b*), *P*2 = (Ú, Ù, Ø, ~), *P*3 = (Ú, Ù, ~, *e*), *P*4 = (Ú, Ù, Ø, *a*, ~), *P*5 = (Ú, Ù, ~, *e*, Ø).

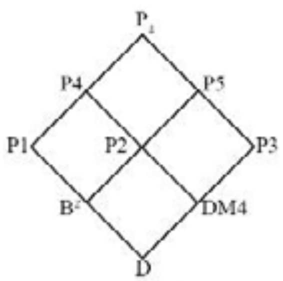

Figure 1

A lattice of these classes w.r.t. relation of functional inclusion is shown in Figure 1:

Taking into consideration functional classes from central "row" of the lattice (i.e. classes *P*1*, P*2 and *P*3), we find out that these classes are functionally equivalent to the following modal logics: the first one is four-valued Łukasiewicz's modal logic (1953), the second one is Sobochiński's modal logic *V*2 (1964) and the third one is von Wright's truth logic *T''LM* (1985). The author of this paper entitled these logics as fundamental four-valued modal logics. *P5* is equivalent to Łukasiewicz logic $Ł_4$, and *P*4 has not been investigated before.

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Causal Models, Conditional Logic, and Cycles of Counterfactual Dependence

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An important component in the interventionist account of causal explanation is an interpretation of counterfactual conditionals as statements about consequences of hypothetical interventions. The interpretation receives a formal treatment in the framework of functional causal models (aka structural equation models). In Pearl (2000)'s influential formulation, functional causal models are assumed to satisfy a "unique-solution" property; this class of Pearlian causal models includes the ones called recursive. Halpern (2013) showed that every recursive causal model is Stalnakerian --- in the sense that there is a Stalnakerian possible-world model that validates the exact same formulas as the causal model does (in a language that does not allow nested counterfactuals or counterfactuals with disjunctive antecedents) --- but some Pearlian models are not Stalnakerian. In this paper, we show that not every Stalnakerian causal model is recursive, and we provide a characterization of the class of Stalnakerian causal models and a complete axiomatization with respect to this class. Our characterization is philosophically interesting, in that the class of Stalnakerian causal models is shown to be precisely the class of Pearlian models that do not contain any cycle of counterfactual dependence (in a sense of counterfactual dependence akin to Lewis's famous relation between distinct events). Finally, we go beyond the class of Pearlian causal models by also considering models that admit multiple solutions, and generalize the previous results.

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The Curious Status of the Principle of Conditional Non-Contradiction

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The principle of *conditional* non-contradiction, CNC, asserts that any pair of conditionals of the form $\alpha \mathrel{\Box\!\!\rightarrow} \beta$ and $\alpha \mathrel{\Box\!\!\rightarrow} \neg\beta$ is inconsistent.

Whereas connexive logics take Aristotle's or Boethius's Theses – variants of CNC – as cornerstones of a logic for conditionals (McCall, 2012), this is not the case for the standard conditional logics of (a) Lewis (1973), (b) Stalnaker (1968), and (c) Adams (1975). Despite this, Bennett (2003) and Gibbard (1980) claim that CNC is valid in (a)–(c), a claim which is erroneous.

CNC is neither valid in (a)–(c) nor can it consistently be added to (a)–(c). Even a restricted version of CNC – where α is required to be consistent – holds in (c)'s probabilistic semantics only and is neither valid in the modal semantics of (a) and (b) nor in Adams's earlier probabilistic semantics (Adams, 1966).

Finally, adding rCNC makes the resulting logic non-monotonic, as CNC employs a non-derivability (consistency) condition. Moreover, by adding rCNC the definition of $\Box\alpha$ by (i) $\neg\alpha \mathrel{\Box\!\!\rightarrow} \alpha$ becomes obsolete, as (i) becomes unsatisfiable whenever α is consistent.

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Reflexive insensitive modal logics

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This talk deals with modal logics that are rendered insensitive to the presence or absence of reflexivity in the accessibility relation by a suitable modification of the standard semantics. Specific examples of such logics can be found in [3] and in [1]. In [1] a sound and compete axiomatization of the minimal logic for such a semantics was provided. This result was improved by [2], accounting for the analogs of T, S4 and S4.3. In this paper we show how to associate a normal modal logic L with its reflexive insensitive counterpart, which we call L°, and give a general theorem describing the conditions under which characterization results for L° follow from the analogs for L.

We will show that different normal modal logics can be associated to the same reflexive insensitive logic. This fact will give rise to a general framework that allows us to extend the results from [1] and [2]. The first theorem in this direction is the following.

Theorem 0.1. *Let $K+\Gamma$ be a normal modal logic axiomatized by the addition of Γ to K. Furthermore, assume $K+\Gamma$ to be complete with respect to some class of frames $\mathbb{C}$. Then $K^\circ+\Gamma^\circ$ is complete with respect to all $\mathbb{C}'$, such that $\mathbb{C}' \leftrightsquigarrow \mathbb{C}$ (where $\mathbb{C}' \leftrightsquigarrow \mathbb{C}$ if and only if any frame in one class is obtained from a frame in the other class by adding and/or removing reflexive arrows).*

Other results we obtained strongly suggest the following conjecture, for which a proof is under construction.

Conjecture 0.2. *Let $K+\Gamma$ be a normal modal logic that is sound and complete with respect to some class of frames $\mathbb{C}$, where Γ is a set of instances of the Lemmon-Scott schema. Then $K^\circ+\Gamma^\circ$ is sound with respect to $\mathbb{C}$ if and only if $K+\Gamma$ admits the rule $\vdash \Box\alpha \Rightarrow \vdash \alpha$.*

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A2.4 PHILOSOPHICAL LOGIC

Tuesday, August 4 • 17:00–19:00
Main Building, Room 7

The Logic of Vagueness and Modality

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We characterize, in model-theoretic terms, a combined logic of vagueness and (metaphysical) modality: of D (“determinately”), [] (“necessarly”), and A (“actually”). We aim to be ecumenical between the two main theories of vagueness—supervaluationism and epistemicism—in two respects. First, we aim at a logic that validates only sentences on whose validity epistemicists and supervaluationists can agree. (This is not difficult: while the two camps differ on logical consequence, they tend to agree on what is valid.) Second, the model theory should deliver a semantics—in the sense of a theory of truth-conditions—that is acceptable to both supervaluationists and epistemicists. Of course, supervaluationists and epistemicists have different semantic conceptions, so we offer two different ways of extracting a semantics from the model theory.

The key idea in the paper is that in order to achieve these goals, the model theory will have to be three- dimensional: a sentence in a model is evaluated for truth relative to a triple w,v,u of “worlds”. We cannot capture all the validities we want with double-indexing, which is the standard approach to the logic of [] and A. In the 3D semantics, D (interpreted by an accessibility relation) shifts w, [] shifts u, and A forces its operand at w to be evaluated as at v.

The Logic of the Indicative Conditional: An Expressivist Analysis

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The Ramsey Test is held to provide an `expressivist semantics’ for the indicative conditional. In this paper I propose a corresponding expressivist semantics for the standard boolean connectives (negation, conjunction, disjunction) that combines with the Ramsey Test to yield a general expressivist semantics for sentences or arbitrary logical complexity containing Ramsey-style conditionals (thus solving the `embedding problem’). The proposed semantics makes use of the distinction -- familiar from the so-called AGM-framework for belief revision -- between *expanding* a mental state and *revising* it. The standard boolean connectives can be fully analysed using the notion of an expansion while the indicative conditional requires a notion of revision. It is shown how the corresponding notions of expansion and revision can be characterised in a way that fully captures classical logic (for the boolean connectives) while generating a logic for the indicative conditional that is sensitive to the many issues (failure of antecedent strengthening, failure of modus ponens, the contextual restriction of modal context) that are known to affect the indicative conditional. The paper provides a fully formal characterisation of these notions and presents a complete axiomatisation of the resulting logic --an expressivist analysis of the logic of the indicative conditional.

Logic and the Sense of Necessity

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Following Wittgenstein of the Tractatus, that the only necessity that exists is logical necessity, this paper argues judgments of correctness and incorrectness in cultural practices like art or the law are, essentially, logical judgments. The paper suggests that logical understanding itself is the ability to understand necessity. Hence, tautologies are not merely propositions that are true on all instantiations of their variables (in basic PC), the point is that they are necessarily true. Likewise, the conclusion of a logically valid argument is not merely true if the premises are, it is necessarily so. This concept of necessity – we could say the concept of necessity; as there is no other – is exhibited by our logical calculi, but it is understood by sense. It is a deep-seated and fundamental intuition which senses logical force per se, thus construed as necessity. This basic sense of necessity that logic affords us is then carried over to other cultural endeavors. Any field governed by a system of rules will bear its own unique internal logic. In fact, that internal logic is precisely what makes the system a system. Hence, all such cultural practices, like art, the law, games etc., will, in a crucial respect, behave the same way: logically. When one is engaged in the practice of such a field, be it panting a cubist picture or making a move in chess, that very same “intuition of necessity” that logic expounds is at work. It is offered, then, that an aesthetic judgment, for instance, as to the correctness or incorrectness of a particular feature in a work of art is, in essence, a logical judgment.

Implicational Logics and iterated Modus Ponens

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Short Abstract: Implicational logics are logics with only implication connective. Compared to other logics/semantics these implicational logics are quite different because none of them has any unsatisfiable set of sentences. However, it is proved that in such systems the model existence property (every consistent set has a model) can be developed (in a weak sense) using the so-called E-consistency (see [2]). In this talk we will improve the result to systems using weak inference rule, the iterated Modus Ponens $MP(k)$, which means from p and $p \to^k q$ it infers q. Here $p \to^k q$ is defined inductively by: $p \to^{k+1} q$ is $p \to (p \to^k q)$, and $p \to^1 q$ is $p \to q$.

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A2.5 PHILOSOPHICAL LOGIC

Thursday, August 6 • 14:30–16:30
Main Building, Room 8

The establishment of mutually inverse implication proposition

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The truth table for → (see Table 1)correctly reflects the establishment of sufficient but not necessary condition. The truth table for ↔ (see Table 2) correctly reflects the establishment of sufficient and necessary condition.

Table 1 Table for →   Table 2 Table for ↔   Table 3 Establishment of ≤-1

A	B	A→B	A	B	A↔B	A	B	A≤-1B
F	F	T	F	F	T	F	F	T
F	T	T	F	T	F	F	T	n
T	F	F	T	F	F	T	F	F
T	T	T	T	T	T	T	T	T

Proposed by the author, the establishment of mutually inverse implication proposition A≤-1B, i.e. A is a sufficient condition of B (see Table 3), combines Tables 1 and 2 in this way: the common part of → and ↔ is that in both cases A is a sufficient condition of B, and the common parts of Tables 1 and 2 are the first, third, and fourth row, as A≤-1B means A being a sufficient condition of B, Table 3 inherits the first, third, and fourth row of both Table 1 and Table 2; the different part of → and ↔ is that in → B is not a sufficient condition of A, while in ↔ B is a sufficient condition of A, and in Tables 1 and 2, the second row is different, since A≤-1B does not care whether B is a sufficient condition of A or not, the second row of Table 3 is n (need not determine whether A is false and B is true or not).

→ has implicational paradoxes: (1) if the antecedent is false or the consequent is true, then the antecedent implies the consequent; (2) there can be no nexus of contents between the antecedent and the consequent. Before an mutually inverse implication proposition is established, it requires: (1) the antecedent is not permanently false and the consequent is not permanently true; (2) the antecedent and the consequent share the same variable. Therefore, ≤-1 is free of implicational paradoxes.

The establishment of ≤-1 is divided into explicit establishment and implicit one.

Type-Theoretical Approaches to Problems and Solutions

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We examine two possible approaches to the formal treatment of the notion of problem in the type-theoretical paradigm. More specifically, we will explore an approach put forward by Martin-Löf's Constructive Type Theory (abbr. CTT, based on BHK interpretation of intuitionistic logic and Curry-Howard-de Bruijn correspondence), which can be seen as a direct continuation of Kolmogorov's original calculus of problems, and an approach put forward by Materna utilizing Tichý's Transparent Intensional Logic (abbr. TIL, based on partial lambda calculus and ramified classical type theory), which can be viewed as a realist attempt of interpreting Kolmogorov's logic of problems. Thus both of these theories can be seen as building upon Kolmogorov's first key insight that (constructive) logic is better understood as dealing with problems rather than with propositions.

We conclude that neither of these theories can be considered at their current state as providing satisfactory account of the notion of problem. CTT due to its insufficient treatment of empirical problems (specifically, it is unclear how to apply the concepts of canonical and non-canonical proofs in the realm of empirical discourse). TIL due to its incomplete analysis of non-empirical problems (specifically, its inability to track, and thus distinguish different logical proofs).

We propose our own approach called Transparent Intensional Logic of Problems (abbr. TILP, an extension based on modified TIL emulating some of the properties of CTT) that tries to combine strengths of both approaches without retaining any of their weak points. Further, TILP can be seen as building upon Kolmogorov's second (and often neglected) key insight that (constructive) logic is best understood as dealing with both problems and propositions, but without conflating them together.

Dialectic Logic: Mathematical Archeology or Mathematical Technology?

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For two hundred years, *Hegel's Dialectic Logic* was a relevant conceptual instrument (just consider its significance in the ideas of Marx and Engels) though a mathematical ectoplasm that only in the last fifty years turned into a mathematical problem.

Here we are building up some *general considerations* related to the *mathematical nature of Dialectic Logic* (***DL***) developed through *model–theoretic instruments.*

Hypothesis for Dialectic Logic. Our basic thesis is that, conceptually, the *Dialectic Logic* is centered upon the following ideas:

- there is a positive form of conflict situations, called *contradictions*
- these contradictions can be *synthesized* in a *more developed context* solving their incompatibilities
- the conceptual contexts incorporating these contradictions are incompatible with the formal reasoning.

Hypotheses against Dialectic Logic. Inside mathematics, the risk is that *a contradiction allows to deduce each statement* (the so-called *explosion argument*, known since the 12th century).

- In a basic logic context, this argument is a consequence of the *Non Contradiction* (*NC*), *Excluded Middle* (*EM*) and *Philonian Implications* (*PI*) laws, and then holds only for the *classical logics*.
- Nevertheless, in a model–theoretic context, it is possible to prove that the explosion argument depends only on the fact that the logic language cannot be changed, namely due to a *Rigidity of Language* (*RL*) law [V1].

A Technical Dichotomy. Developing this background in a model–theoretic context, it is possible to consider two general approaches for the mathematics of the dialectic logic.

- *A classical approach,* founded on *non–classical logics* (that does not satisfy *NC, EM* or *PI),* where it is possible to build some minimal non–explosive contradictory logic [V1], that does not satisfy at last one of *NC*, *EM* and *PI.* In addition, these logics can be combined with each other obtaining, e.g., a contradictory non–explosive logic that satisfies neither *EM* nor *PI*. In this way it is possible to obtain model–theoretic versions of *Paraconsistent logics* [DKB]*, Logic of Formal Inconsistency* [CCM], and *Petersen Diagonal logic* [P].
- *A non classical approach*, founded on *classical logics* that does not satisfy *RL*. In this case the non–explosive contradictions are the counterexample of *Robinson Property* and their presence negates some basic logical properties like *Compactness* and *Interpolation* [V2].

Assuming that a formal description of a logic is *pure* when it is self-sufficient [V3], the relationship between this logic and the above general properties of ***DL*** are the following:

logic	*contradiction*	*synthesis*	*formalisability*
paraconsistent	*consistent*	*no*	*pure*
of Formal Inconsistency	*partially consistent*	*no*	*pure*
diagonal	*potentially inconsistent*	*yes*	*impure*
non rigid	*potentially inconsistent*	*yes*	*impure*

An Eschatological Dichotomy. Apart from the technical result, each mathematical approach to dialectic logic faces with an 'eschatological dichotomy', in which the ultimate aims of the mathematics of DL are confirming that dialectic logic is a scientifically founded methodology (in a sort of mathematical archeology), or developing a new mathematical instrument inspired to dialectical ideas (developing a dialectic part of mathematical technology). Since the development of the various ***DL*** approach is relatively recent, the discussion concerning the archeological or technological nature of the various non-explosive contradictory logics is in progress.

In this perspective, a possible risk is that the use of non–classical logics — making necessary rebuild entire parts of mathematics — would make difficult the use of the relative *Dialectic Logics* in the working mathematics and limit their relevance to the *archaeology.*

On the other hand, some results seem to indicate mathematically (and then objectively?) that the *classical non–rigid description* of ***DL*** is *technological.* As a matter of fact, following the distinction between *Interpolation–like* and *Compactness–like* contradictions, it is possible to prove that, for a large class of model–theoretic logics L's,

Theorem 1 [V3]. L *has a pure formalization* ⇔ L *satisfies interpolation.*

Theorem 2 [V4]. *Each non–compact logic* L *developed in a given set–theoretic context can be make compact in a richer set–theoretic context.*

The first theorem shows that the interpolation–like contradictions suffice to confirm the incompatibility between ***DL*** and the formal reasoning. The second one shows the other possible contradictions of this approach, individuating a specific relation to the set–theoretic meta–theory of a logic, and opening to a certain use of dialectic reasoning unthinkable at Hegel's times.

[CCM] Carnielli W. A., Coniglio M. E., Marcos, J. *Logics of Formal Inconsistency* [Gabbay D., Guenthner F. (eds.), *Handbook of Philosophical Logic*, 2nd Edition. Vol. 14, Kluwer Academic Publishers, 2007: *1–93*]. [DKB] Da Costa N. C. A., Krause D., Bueno O. *Paraconsistent Logic and Paraconsistency.* [Gabbay D.M., Thagard P., Woods J. (eds.) *Handbook of the Philosophy of Science. Volume 5: Philosophy of Logic.* Elzevir BV, 2006: *655–781*]. [P] Pedersen U. *Diagonal Method and Dialectical Logic. Tools, Materials, and Elements for a Logical Foundation of Dialectic and Speculative Philosophy.* Der Andere Verlag: Osnabrück, 2002. [V1] Vincenzi A. *A Model–Theoretic Approach to Contradictions.* Submitted. [V2] Vincenzi A. *A Model–Theoretic Description of Dialectic Logic.* In preparation. [V3] Vincenzi A. *Interpolation and Formalization.* Submitted. [V4] Vincenzi A. *Compactness and Set Theory*. Submitted.

A2.6 PHILOSOPHICAL LOGIC

Tuesday, August 4 • 17:00–19:00
Main Building, Room 8

Gödel's Claim that Intuitionistic Logic is a Renaming of Classical Logic and Davidsonian Radical Interpretation: Some Considerations

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May the theory of radical interpretation developed by Davidson (e.g. in Davidson [1973] 2001) help fix the meaning of the logical constants? If so, how and with what results? In particular, may the theory promote ways of fixing their meaning which should be accepted as exclusively correct and force an interpreter to reject other ways of fixing them as illegitimate? I examine the case of negation, disjunction and the existential quantifier, both in the context of a Davidsonian situation of radical translation and in the context of Gödel's objections to the intuitive and informal constructive definitions of "¬", "v" and "(∃x)" presented in Gödel [1941] 1995, prior to the Dialectica paper of 1958 (Gödel [1958] [1972] 1990).

I conclude first that Davidson's interpretative strategy fails to provide a reason to believe that to change the meaning of the constants is, as the Quinean saying goes, "to change the subject," and to prefer the classical reading to the intuitionistic one. Secondly, I conclude that despite Gödel's objection that intuitionistic logic "turns out to be rather a renaming and reinterpretation than a radical change of classical logic" (Gödel [1941] 1995: [3] 190), there remains a further disagreement over the meaning of the constants. Consider negation. When one applies the principle that ascription of meaning to the ascribee's constant should be identical to that made by the ascriber to his own, the non-equivalence of the classical reductio or absurdity rule to the intuitionistic one may, in some very weak sense, be judged irrelevant to the debate over the meaning of the constant. But when one applies a stronger principle according to which any ascription of meaning to that constant should be grounded or justified irrespective of who is responsible for the ascription, the non- equivalence of "~" (classical) and "¬" (intuitionistic) is conspicuous.

Of course, under Glivenko's translation of the classical constants into the intuitionistic ones, the classical calculus turns out to be a subsystem of the Heyting propositional calculus (Glivenko 1929). Adding a definition of existence such that (∃x) A(x) ?DF ¬ (x) ¬ A(x), non-constructive existence proofs become intuitionistically correct. I examine Gödel's critical reflexions regarding the extent to which classical existence proofs may be transformed into constructive ones for the formulas of Σ (an early version of the system T of the Dialectica paper of which Gödel [1941] 1995 is an ancestor). I argue that in spite of Gödel's negative remarks on the imprecise or informal notion of constructibility (to the point where the very notion of constructive proof provides a counter-example to its own admissibility unless it is understood in terms of derivation in a formal system), there is still ground for a disagreement over the meaningfulness, understanding or grasp of classical proofs. In the Davidsonian context, the translation of one idiom containing the classical "~", "v" and "(∃x)" into another might perhaps maximize agreement, but the settlement thereby obtained takes for granted that there is no further disagreement over the possibility that the truth of sentences containing occurrences of these constants is independent from the capacity of both ascribers and ascribees to provide justifications for them. Such an independence remains a sticking point despite the merits of Glivenko's and Gödel's approach.

REFERENCES: Davidson (Donald), [1973] 2001, "Radical Interpretation," Inquiries into Truth and Interpretation, Clarendon Press, Oxford, 2nd edition, pp. 125-140. Glivenko (Valerii Ivanovich), 1929, "Sur quelques points de la logique de M. Brouwer," Académie royale de Belgique, Bulletin de la classe des sciences, vol. 5 (15), pp. 183-188. Gödel (Kurt), [1941] 1995, "In what sense is intuitionistic logic constructive?," Collected Works, Volume III: Unpublished Essays and Lectures, S. Feferman, Ed.-in-Chief, Oxford UP, New York and Oxford, pp. 189-200. - [1958] [1972] 1990, "Über eine bisher noch nicht benütze Erweiterung des finiten Standpunktes / On an extension of finitary mathematics which has not yet been used," Collected Works, Volume II: Publications 1938 -1974, S. Feferman, Ed.-in-Chief, [1958] revised and expanded in English as [1972] by W. Hodges and B. Watson, Oxford UP, New York and Oxford, pp. 271-280.

CONTRIBUTED PAPERS / A2.6 PHILOSOPHICAL LOGIC

Two perspectives towards many-valued logic: philosophical and mathematical one

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The paper presents two perspectives towards many-valued logic: philosophical and mathematical one. It indicates that in some cases, mathematical perspective is a foundation of a critique of the philosophical idea of many-valuedness. The philosophical (rather ontological than epistemological) perspective is grounded in J. Lukasiewicz's pioneering works on three-valued logic. Lukasiewicz introduced the third, intermediate truth-value 1/2, different from 1 (i.e., from the true) and different from 0 (i.e., from the false), assigned by propositions on the future states of affairs that are neither true nor false, but which are just possible true and possible false. Thus the truth-value 1/2 has the ontological meaning referring to the contingent nature of the future states of affairs. Philosophically motivated investigations on many-valued logic were continued by many logicians and mathematicians, for example, by D. A. Bochvar and S. C. Kleene. Bochvar considered the third truth-value as the undecidability, Kleene – as the undeterminability. On the other hand, the mathematical perspective towards many-valued logic is grounded in E. Post's works. Post's n-valued (n-finite) 'logic algebras' that save the classical property of functional completeness of the set of connectives, were introduced with the completeness proof of the classical logic. The mathematical perspective provides some formal tools that can be used against the philosophical idea of many-valuedness. R. Suszko presents a purely mathematical proof according to which every propositional (structural) logic is a two-valued one. Therefore, Suszko maintains that the third truth-value lacks not only philosophical, but also logical meaning. We can also find constructed by mathematical means, a critique of many-valuedness hidden in the theory of the standard conditions presented by J. B. Rosser and A. R. Turquette. Although, this theory solves some meta-logical problems (axiomatization and the extension to predicate logics), it makes many-valued logics resemble the classical propositional logic.

Belnap's logic as a logic of experts

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Belnap's logic (also called first-degree entailment) is the most influential four-valued logic. We will take {0,1,n,b} as the set of semantic values and will focus on applications of Belnap's logic where the values represent the quality of the information about the truth of sentences: when the sources of evidence all speak in favor of a sentence, its value is 0; when all sources are against the truth of a sentence, the value is 1; when there is no information, the value is n, and when there are some sources in favour and others against the sentence the value is b.

Even though Belnap's logic gives an important set of valid arguments, the definitions of the operators present some anomalies (as was originally recognized by Belnap himself and later on by Camp). Consider, v.gr., $n \wedge b = 0$. On the epistemic interpretation, if there is no information about p and contradictory information about q, one should draw the conclusion that all the evidence is against $p \wedge q$. We want to argue that this assignment of truth values is an anomaly.

In the talk we will consider the specific case where the sources of information are experts that give their opinion on the truth value of sentences. Our aim is to analyze in detail how the logic of each expert can be combined into a logic for the group of experts. Some of the well-motivated combinations will take us to Belnap's logic and will solve the anomalies, other combinations will create logics different from Belnap's. As an example, if each expert uses a strong Kleene logic with semantic values E={0,1,n}, then a natural combination of the logics into a group logic will use as semantic values non-empty subsets of E. Once the details of the semantics are given, it can be proved that the seven-valued logic that is generated coincides with Belnap's logic and has no anomalous assignation of semantic values.

Classical many-valued logic and the bottom-line preservation notion of logical consequence

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It seems reasonable to deal with statements involving vagueness, such as 'John is bald' and 'Mike is on Kilimanjaro', by assigning not the ordinary two values, truth (or 1) and falsity (or 0), but many values between 0 and 1. A couple of plausible constraints on such a value assignment, V, is that for any proposition p, (1) $[\![p \vee \neg p]\!]^V = 1$; and (2) $[\![p]\!]^V + [\![\neg p]\!]^V = 1$. However, neither fuzzy logic nor the many-valued version of supervaluationism, two of the most popular many-valued logics of vagueness, satisfies both constraints. This is often cited as evidence that neither is a good logic of vagueness. So a logic of vagueness that satisfies both (1) and (2) is wanted. This paper presents such a logic and defends the non-standard notion of logical consequence that exists behind it.

The basic idea for the logic is to use for the relevant values Boolean many-values in many-valued Boolean algebras. Specifically, take B as any (finite or infinite) non-degenerate complete Boolean algebra such that $B = \langle D, \wedge, \vee, -, 0, 1\rangle = \langle D, \leq\rangle$, where D is the domain of B, $\wedge, \vee$, and $-$ are the glb, lub, and complement associated with B, and 0 ($= p \wedge \neg p$ for any p) and 1 ($= p \vee \neg p$) are the bottom and top elements of B. $\leq$ is the partial order that determines B. Then a general Boolean valuation V on B for compound sentences is $[\![\neg p]\!]^V_B = -[\![p]\!]^V_B$, $[\![p \wedge q]\!]^V_B = [\![p]\!]^V_B \wedge [\![q]\!]^V_B$, and $[\![p \vee q]\!]^V_B = [\![p]\!]^V_B \vee [\![q]\!]^V_B$. Consequently, $[\![p \vee \neg p]\!]^V_B = [\![p]\!]^V_B \vee [\![\neg p]\!]^V_B = [\![p]\!]^V_B \vee -[\![p]\!]^V_B = 1$; so both (1) and (2) above hold. Conjunction, disjunction, and negation can be treated truth-functionally.

As for the notion of logical consequence, we propose:

$$\Gamma \vDash_B \Delta \Leftrightarrow_{df} \bigwedge_{p \in \Gamma} [\![p]\!]^V_B \leq \bigvee_{q \in \Delta} [\![q]\!]^V_B \; (\Leftrightarrow -\bigwedge_{p \in \Gamma} [\![p]\!]^V_B \vee \bigvee_{q \in \Delta} [\![q]\!]^V_B = 1) \text{ for any } V \text{ on } B.$$

We generalize this and obtain:

$$\Gamma \vDash_{BMV} \Delta \Leftrightarrow_{df} \bigwedge_{p \in \Gamma} [\![p]\!]^V_B \leq \bigvee_{q \in \Delta} [\![q]\!]^V_B \text{ for any } V \text{ on } \textit{any } B$$

(where BMV = Boolean many-valued logic). Then $\Gamma \vdash_{CL} \Delta \Leftrightarrow \Gamma \vDash_{BMV} \Delta$ (where CL = classical logic). So even though BMV is a many-valued logic, it is a classical logic. Classical logic was not tied to two truth values from the beginning.

Here the notion of logical consequence employed is not the standard notion of *truth preservation* (or, generally, *designated values preservation*) but the notion of *bottom-line preservation*: the lowest value (infimum) of the premises (or the value of the conjunction of the premises) is no higher than the highest value (supremum) of the conclusions (or the value of the disjunction of the conclusions). We shall defend this non-standard notion of logical consequence. The notion is convenient because, among other things, the multiple premises/conclusions in any argument retain their bottom/top-lines even when they are conjoined/disjoined. Also, we can move a premise to a conclusion and a conclusion to a premise easily by adding a negation $\neg$, i.e., $\Gamma, p \vDash_{BMV} \Delta \Leftrightarrow \Gamma \vDash_{BMV} \Delta, \neg p$ and $\Gamma \vDash_{BMV} \Delta, q \Leftrightarrow \Gamma, \neg q \vDash_{BMV} \Delta$. These features, along with truth-functionality, do not obtain in fuzzy logic or supervaluationism.

A2.7 PHILOSOPHICAL LOGIC

Friday, August 7 • 14:30–16:30
Main Building, Room 3

Grades of specifiability

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The discernibility of objects has been a topic of great interest, at least since the time of Leibniz. In the last decade or so, research in this area has been intense, especially by using tools and methods of first-order logic. Out of the four grades of discernibility that have been studied (see, e.g., J. Ladyman, O. Linnebo and R. Pettigrew, Identity and Discernibility in Philosophy and Logic, Review of Symbolic Logic 5 (2012), 162-186) three were essentially introduced by W. V. Quine (Grades of discriminability, Journal of Philosophy 73 (1976), 113-116). A thorough study of the four grades of discernibility is considered worthwhile, given that they have been used (see, e.g. A. Caulton and J. Butterfield, On kinds of indiscernibility in Logic and Metaphysics, British Journal for the Philosophy of Science 63 (2012), 27-84) for stating corresponding metaphysical theses (about the identity relation), which are thought to be closely related to structural realism. Closely connected with the notion of discernibility is the notion of specifiability of objects, which was also introduced by Quine (in the paper mentioned above). We will define grades of specifiability of objects and study them, within a specific model- theoretic framework. While the usual transition from intrinsic to extrinsic properties is based solely on the existence or not of quantifiers occurring in the (first-order) formulas which define the properties considered, our approach lays emphasis on the number of quantifier alternations in these formulas, so that we are led to an (infinite) scale of grades of specifiability. We will refer briefly to relationships existing at various levels of this scale and discuss the prospect of exploiting them to solve the question posed by Quine, i.e. whether or not there exist grades of extrinsic indiscernibility which differ from the ones studied by him.

A Free Logic for Fictionalism

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Fictionalism is a fashionable and timely doctrine in many quarters of contemporary philosophy. It has fueled and channeled important debates in metaphysics (ontology), philosophy of language and philosophical logic, for its having a genuine explanatory virtue: even if it is extremely hard to buy into the full ontological existence of, say, unobservable things, or abstract things, or fictional objects, or nonfactual (and merely possible) things, or even moral values, one could, nevertheless, endorse forms of meaningful discourse which are about those sui-generis objects. Various kinds of fictionalism will help us in this regard: the things on which we think in those forms of discourse have to be accepted by us, even if they do not qualify ontologically, semantically, or epistemologically as being truth-apt or as truth-makers or truth-bearers.

Against this background, my paper aims at disentangling certain logical principles that govern the meaningful fictional discourse on fictional objects. The ontological thesis concerning fictional objects that I endorse is that fictional objects are essentially objects of reference, i.e. objects created through a story or a narrative and introduced via a cluster of descriptions.

The main point that I am going to make in my paper is this: in order to articulate the logical principles which govern the meaningful discourse on fictional objects what we need is a sort of free logic. The issue is: what kind? Now, a major motivation for developing free logics systems has always been to provide a basis for theories of definite descriptions. Having in view the essential connection between any given fictional object term and the cluster of descriptions through which the former is introduced, I argue that the kind of logic we need for fictionalism and fictional objects discourse is a positive free logic with free descriptions.

Why Is There Something Rather Than Nothing? A Logical Investigation.

Heylen Jan
Institute of Philosophy, KU Leuven, Leuven, BELGIUM

Leibniz's question 'Why there is something rather than nothing?' continues to attract attention, as witnessed by A Universe From Nothing: Why is There Something Rather Than Nothing? (Simon and Schuster, 2012), written by the physicist Lawrence Krauss, and Why Does the World Exist? An Existential Detective Story (W. W. Norton & Company, 2012), written by John Holt. I want to study the question from a logical perspective. I will start with the logic of why-questions (Hintikka and Halonen 1995; Schurz 2005). An answer to a why- question is an explanation. Ultimately, an explanation has the form of an argument. The background logic cannot be classical first-order logic with identity, since it is a theorem of that logic at least one thing exists. We have to consider free logics (i.e. logics that are free of existential commitments) instead. These come in three main varieties, viz. negative, positive and neutral. I will prove that, if negative free logic is the background logic, any argument with an existential sentence as conclusion has at least one premise that is logically equivalent to an existential sentence. Next I will prove that, if positive free logic is in the background, any argument with an existential sentence as conclusion has at least one premise that is logically equivalent to an existential sentence or it has at least two premises the conjunction of which is logically equivalent to an existential sentences. Both results are taken to imply that any answer to the big question is question-begging. Using neutral free logic is to no avail either. The conclusion is that the question cannot be answered adequately. My position is similar to Grünbaum's (2009), although the reasons differ. In the course of my investigation I will also look into the combination of free logic with the disquotational theory of truth.

Speaking of Essence

Torza Alessandro
Instituto de Investigaciones Filosóficas, UNAM, México DF, MEXICO

Classical modalism about essence is the view that essence can be analyzed in modal terms. Despite Kit Fine's influential critique, no general refutation of classical modalism has yet been given. In the first part of the paper I provide such a refutation by showing that the notion of essence cannot be analyzed in terms of any sentential operator definable in the language of standard quantified modal logic. As a reaction to Fine's critique, some have defended sophisticated modalism, which attempts to analyze essence in an enriched modal language quantifying over both possible and impossible worlds. In the second part of the paper I argue that sophisticated modalism falls prey to variations on Fine's counterexamples to classical modalism. I conclude that the most promising approaches to understanding the notion of essence consist in taking essence either as primitive or as analyzable via a combination of modal and non-modal notions.

A2.8 PHILOSOPHICAL LOGIC

Wednesday, August 5 • 11:00–13:00
Main Building, Room 15

The predicate approach to de re modalities

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There are advantages in treating modalities as predicates rather than modal operators as in modal logic. I have argued that that various problems supposed to dodge attempts to develop a predicate account of modality can be overcome. In particular, the predicate approach doesn't preclude us from giving a possible worlds semantics for modalities. I'll look at another challenge for predicate accounts of modalities: de re modalities. I'll look into the consequences of treating necessity as a binary predicate applying to formulae with free variables (or relations) and variable assignments (or sequences of objects). I will argue that such a treatment of modal predicates yields certain consequences for metaphysics; in particular, it provides support for necessitism.

On the Decidability of Atomic Mereological Theories

Tsai Hsing-chien
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Traditionally, a mereological theory is an extension of the theory of partial orderings and there are mainly two types of axioms which can be added on top of the axioms of partial orderings (in the following, "Pxy" means "x is a part of y" or "x is smaller than or equal to y" and "Oxy" means "$\exists z(Pzx \wedge Pzy)$"). The first type consists of supplementation principles, for instance, $\forall x \forall y(\neg Pyx \rightarrow \exists z(Pzy \wedge \neg Ozx))$ is called "strong supplementation", and the second type, of closure principles, for instance, for any formula F(x) (which might contain free variables other than x), $\exists x F(x) \rightarrow \exists z \forall y(Oyz \leftrightarrow \exists x(F(x) \wedge Oxy))$ is called "unrestricted fusion". The so-called "classical mereology" is the theory axiomatized by the theory of partial orderings plus the aforementioned two principles. There is another kind of principles specifying whether everything is built up with most basic elements. For instance, $\forall x \exists y(Pyx \wedge \neg \exists z(Pzy \wedge \neg Pyz))$ is called "atomicity". A mereological theory with atomicity, or simply "atomic mereological theory", will indeed have atomic models if it is consistent. This talk will look into the decidability issue of some atomic mereological theories, and most of the results here will be shown by using a method of model theoretical reduction, which in effect is about how to define an atomic model into another atomic model. Atomic models are intuitively much easier to handle and the method to be introduced can in many cases be carried out easily by drawing diagrams. Such a method is very useful for proving negative results, since a mereological theory T is undecidable if any of its finite extensions, in particular, the extension formed by adding atomicity, is undecidable.

A Hypersequent Calculus for Contingent Existence

French Rohan
Theoretical Philosophy, University of Groningen, Groningen, NETHERLANDS

It is well known that the most straightforward way of adding rules for the quantifers to any adequate sequent calculus for the modal logic S5 allows for the derivation of the Barcan Formula|9x' ! 9x'. This result is philosophically undesirably as, contra the Barcan Formula, common-sense metaphysics would have it that things can possibly exist without actually existing. In this paper we give an account of what is suspect about such derivations by making use of a modal object language with primitive scope indicators in which, in addition to their usual `object denoting' role we also employ terms in a `scope indicating' capacity. Using this modal object language we can diagnose the derivability of the Barcan formula in the standard language as arising out of the elision of a scope distinction between `possibly, a is F' (written in this language as \ a Fa") and `concerning a, possibly it is F' (written as \a Fa"), where we are only able to infer \9xFx" from the second of these formulas. In order to manipulate this object language we make use of `importation' and `exportation' rules which govern the movement of scope indicators in addition to more standard left- and right-insertion rules. Furthermore, we also make use of a distinction between rules which introduce a context into which we can quantify, and those which (prior to the use of importation/exportation rules) we cannot|the rules for negation and the modal operators being of this second kind. The resultant modal hypersequent calculi provided is sound and complete w.r.t. first-order Kripke models with non-constant domains.

Illocutionary Acts and Arguments

Kearns John
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This talk is concerned to articulate a conceptual framework which accommodates the different areas of logical research that have been, and that can be, carried out. The leading idea of this framework is provided by speech act theory and illocutionary logic. A speech act, or language act, is a meaningful act performed by saying, writing, or thinking with words. Sentential acts are the minimal language acts performed with sentences or sentential clauses. A typical illocutionary act is constituted by a sentential act performed with a certain force, like the force of an assertion, a request, or a promise. These sentential acts are locutionary acts. John Searle has developed a taxonomy of illocutionary acts, the three important categories for my project are assertives, directives, and commissives. The locutionary acts that figure in assertive acts are statements, sentential acts which are evaluated in terms of truth and falsity. For directives, the locutionary acts are plans, which represent an addressee as performing a kind of act or action. Directive acts present plans to addressees for them to implement. Plans which the speaker commits herself to implement also figure in commissive acts.

For each category, there are three types of argument: (1) A locutionary argument, an ordered pair whose first element is a set of locutionary act premisses, and whose second member is a single locutionary act conclusion. (2) A deductive derivation which traces truth or satisfaction condition connections from locutionary act premisses to the locutionary act conclusion. (3) An illocutionary argument whose premisses and conclusion are illocutionary acts. Standard logical theories have pretty much focused on assertive illocutionary acts, and their locutionary arguments and deductive derivations. This leaves seven classes of arguments that are not well understood or sufficiently explored.

A2.9 PHILOSOPHICAL LOGIC

Wednesday, August 5 • 14:30–16:30
Main Building, Room 13

Dependence of quantifiers: Arbitrary objects versus generalised Tarski-type semantics

Sandu Gabriel
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Various logical systems, which deal with arbitrary patterns of dependence of quantifiers, have recently emerged. They originate in the work of Henkin (1961), which, in turn, inspired IF logic (Independence-Friendly Logic). Hodges' compositional interpretation for IF logic (Hodges, 1997) has been the inspirational force for various Dependence and Independence logics which have flourished thereafter. Little attention has been paid, however, to comparative work with the system of arbitrary objects introduced by Kit Fine (1983, 1985). Fine sees the role of quantifiers as introducing arbitrary objects and the (scopal) dependence of one quantifier upon another as introducing a dependence relation between these objects. Formulas with constants denoting arbitrary objects have a level of semantic representation in terms of sets of sets of assignments, like Hodges' semantic interpretation of IF logic. I will take a closer look at the two systems with an eye on natural language applications (functional anaphora).

Word or Thing: Aristotelian Categories

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In Metaphysics 1028a10-15 Aristotle asks the "ti esti" question for sorting out ousia/substance. For Aristotle believes that being has many meanings and if we want to give answers to our "ti esti" question we have to analyze all those meanings: as activity-potentiality; matter-form. In his book Categories Aristotle sorts ten categories for making a classification. However what this classification is about or, in other words, what Aristotle classifies is still a much-debated issue. For on one hand some interpreters believe that Aristotle classifies words and on the other hand other interpreters believe that beings are classified. In this paper second interpretation will be defended. Hence what we classify is not words but things which we are refering to by these words. Therefore Categories is not only a book on logic but it is a book of ontology. For giving details about this proposition I'll try to make an ontological reading of Categories by refering to important passages.

Thereof first of all the four-fold division of Categories will be analysed:

1.1 Not Said-Of and Not Present-In: Such entities, for Aristotle, are primary substances (2a11).

1.2 Not Said-Of and Present-In: Aristotle's example for this is an individual piece of grammatical knowledge (1a25).

1.3 Said-Of and Not Present-In: The secondary substances, which are universals (2a11-a18) like man (1a21),

1.4 Said-Of and Present-In: An accidental universal.

In this manner I'll try to analyse each of this division to shed a light on Aristotle's "being said in many ways" argument and substantiate my arguments about ontological classification of beings in Categories.

Logical Spaces

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When philosophers talk about logical space, they usually refer to the collection of all possible worlds in modal logic. But similar structures are realized in other areas of inquiry, and they differ in philosophically interesting ways from the more familiar geometric spaces, such as the physical space we inhabit. This paper develops a theory of logical spaces that explains what is (and is not) remarkable about them.

Heterodox Models of Peano Arithmetic

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One way of semantically characterizing the received notion of logical consequence [A. Tarski, D. Scott] is by way of certain distinguished truth-values being preserved from the set A of sentences taken as premises to the set B of sentences taken as alternative conclusions. This can also be framed in terms of the incompatibility between the attitudes involved in accepting A while simultaneously not accepting B; equivalently, it may be put in tems of the incompatibility between rejecting B while not rejecting A. Capitalizing on the assumed contradictory opposition between acceptance and rejection, one may then argue that logics are in fact two-valued [R. Suszko], and insisting on the bipolarity of attitudes one may argue that standard logics are, after all, mono-valued [Y. Shramko{H. Wansing]. Heterodox approaches to consequence often proceed by generalizing the standard approach in allowing acceptance and rejection to be independent attitudes, thus preventing the coincidences between acceptance and nonrejection, and between rejection and nonacceptance. In that respect, one well-explored alternative is the notion of q-entailment [G. Malinowski], according to which nonacceptance is allowed to intersect nonrejection, and B is said to follow from A when it is incompatible to nonaccept A while simultaneously nonrejecting B. Dually, according to the notion of p-entailment [S. Frankowski], acceptance may intersect rejection, and B is said to follow from A when it is incompatible to accept A while simultaneously rejecting B. If one strives to characterize such heterodox notions of entailment according to the Tarskian framework, it will appear that standard properties of consequence (such as extensiveness, or cut) fail. However, using a framework that allows for independent collections of distinguished truth-values, all the above notions are easily seen to be particular examples of a more general four-place entailment [A. Bochman]. In our contribution we will show how such uniform framework connects to modern reconstructions of the square of oppositions, to bilattice-based reasoning, and to nondeterministic semantics.

A2.10 PHILOSOPHICAL LOGIC

Wednesday, August 5 • 14:30–16:30
Main Building, Room 15

Justification Logics and Quasi-Truth

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Two approaches to justification logics are studied. The first developed by Newton da Costa deals with "justification" as a modal operator, the second proposed by Sergei Artemov deals with "justification" as a term associated to modal operators. This work explains how to interact these systems of justification, and how the concept of quasi-truth can be defined in both frameworks.

Beyond knowing that: non-standard epistemic logics

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Classical epistemic logic focuses on propositional knowledge (in terms of "knowing that phi"). However, various forms of knowledge are used in everyday life, which suggests non-standard but interesting new epistemic operators. In this talk, I survey our recent line of work on modal logics based on "knowing whether", "knowing what" and "knowing how" operators. These new logics are not normal due to the lack of standard modal axioms, which require new techniques to handle. Many of these logics are essentially decidable fragments of first-order modal logic. As we will demonstrate, the non-standard epistemic operators sit beautifully in between logic, linguistics, computer science, and philosophy. I will focus on the axiomatizations of such epistemic logics in this talk.

Propositional Logics of Dependence and Relativised Knowledge

Goranko Valentin
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Kuusisto Antti
Stockholm University, Stockholm, SWEDEN

We introduce and study the concept of Boolean dependence of a logical statement B with respect to a list of logical statements A1,…,An, meaning that the truth value of B is a Boolean function of the truth value s of A1,…,An defined on a class of models construed as possible worlds. More precisely, this means that in every two models (possible worlds) where each of A1,…,An has the same truth values, B must have the same truth value, too. We extend propositional logic with an operator D(S;B) that formally expresses such dependence, where S is any (finite) list of formulae and B is a formula of the resulting language. We then obtain a sound and complete axiomatization for the resulting propositional logic of dependence (PLD) with respect to the class of sets of propositional valuations regarded as possible worlds, or equivalently, with respect to the class of S5 models. When these models are interpreted epistemically, D(S;B) implies that an agent knows the truth value of B whenever the agent knows the truth values of each of the formulae in S, i.e., that the truth of B is knowable conditionally on the knowledge of the truth of the statements in S. Thus, PLD extends the logics of contingency and of 'Knowing Whether' (Fan, Wang and van Ditmarsch, 2014), on the one hand, and also provides a novel approach to the notion of functional dependence arising in (modal) dependence logic of Väänänen, on the other hand. Further, we generalize the operator D(S;B) to the more expressive operator of relativized Boolean dependence, D^C(S;B), intuitively saying that B is dependent on S in the sense above, but relativised to the set of possible worlds in the model where C is true. We obtain a complete axiomatization of D^C(S;B), too, and discuss some applications.

Truth-functional approach to epistemic logic (and its application to Fitch's paradox)

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It is common to formalize the expressions of the form "agent a knows x" by the use of an epistemic operator Kx. Hintikka (1962) provides a non-functional semantic interpretation of this operator in terms of possible worlds semantics. His interpretation is intuitively clear when the formalization of the fact of knowing something is represented as syntactic operator K. My aim here is to introduce an epistemic system, in which the Koperator does not appear, but the fact of knowing or not knowing some truths (or the falsity of some statement) can be defined truth-functionally. In order to obtain this system, we propose a four-valued logic, that we call the logic of a rational agent. The valuations in this logic are intuitively understood as follows: "true and known to be true" (T1), "true and unknown to be true" (T0), "false and known to be false"(F1) and "false and unknown to be false"(F0). Thus, the fact of knowing something is formalized at the level of valuations, without the use of Koperator. On the base of this semantics, a sound and complete system with two distinct truth-functional negations (an "ontological" and an "epistemic" one) is provided. These negations allow us to express the statements about knowing or not knowing something by an agent at the syntactic level. Moreover, such a system may be applied to the analysis of Fitch's paradox: if we accept the thesis that all truths are knowable, then all truths are already known. In particular, we show that the paradox is not derivable in terms of the logic of a rational agent.

A2.11 PHILOSOPHICAL LOGIC

Wednesday, August 5 • 11:00–13:00
Main Building, Auditorium I

Assertion and the logic of common knowledge

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I propose a characterization of common knowledge (i.e. CGφ) in terms of the knowledge account of assertion in the framework of epistemic logic: (CKA) CGφ ↔ EG(φ∧Aφ). That is, φ is common knowledge for a group G of agents iff everyone (in G) knows that φ is true and φ is an assertion, where one asserts φ (i.e. Aφ) only if one knows φ (i.e. Kφ) in all accessible states with some specified conditions.

I start with an examination of misgivings over current accounts of common knowledge in the orthodox logic of common knowledge, including the iterated account, fixed-point account and the shared-environment approach. Special attention will be paid to a Davidsonian challenge which observes that the logic of common knowledge contains formulas of three proto-types-Kiφ, KiKiφ, and KiKjφ (i?j) but they are treated indifferently. A Davidsonian would insist that they are three varieties of knowledge: (i) Kiφ-factual knowledge, (ii) KiKiφ-self-knowledge; and (iii) KiKjφ (i?j)-knowledge of other minds. Any characterization of common knowledge should explain the differences involved.

I next show that failure of the iterated account (CGφ ↔ (φ∧EGφ∧EGEGφ∧..., ad infinitun) and the fix-point account (CGφ ↔ EG(φ∧CGφ)) suggests a promising approach by appealing to some modality, say X, weaker than CGφ but stronger than EG…EGφ, so that CGφ → EGXφ and EGXφ → (EG...EG)φ (for any n-iterated EG) hold. Moreover, Xφ should signify some outwardly observable, or perceptible, action of human agents in a certain shared situation so that the required complete transparency can be guaranteed. I then argue that the knowledge account of assertion should be the best candidate for Xφ as the proposed thesis (CKA) shows.

Finally, I present a justification for (CKA) in the framework of a kind of models (referred to as TWA-models) for logic of knowledge with assertion. Semantic rules for CGφ, EGφ and Aφ will be specified; basic presuppositions will be formulated explicitly so that the difference of the aforementioned three varieties of knowledge involved in common knowledge can be illuminated.

Dynamic justification logic

Giordani Alessandro
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The present talk aims at introducing and discussing systems of dynamic justification logic apt to characterize possible evolutions of the knowledge set available to an epistemic agent. The sources of evolution of an agent, modeled as a dynamic system embedded in a specific environment, are both of evidential kind (observations) and of inferential kind (computations). A straightforward way to capture these basic sources is to introduce a set of epistemic actions {Ri} and a set of modal operators {Pi,Poss}, plus the operator of explicit knowledge K, so to enrich the modal language with sentences like Pi(KA), stating that A is in some knowledge state after having applied Ri, and Poss(KA), stating that A is implicitly known, i.e. achievable after the application of one of the actions in {Ri}. This approach, initially proposed by Duc (1995) can be developed in at least two ways. Firstly, the model including the knowledge state obtained after any action can be updated in such a way that all the states that are inconsistent with the given one are eliminated, following the approach of the dynamic epistemic logic, (van Ditmarsch et al. 2006; van Benthem 2011). Secondly, the epistemic actions can be construed as actions on epistemic justifiers, thus interpreting the actions as acquisitions or constructions of justifications. This is the approach pursued here. The resultant logic allows us (1) to improve justification logic (Artemov 2008; Fitting 2006) by introducing a crucial distinction between implicit and explicit justifiers, and a further distinction between directly and indirectly accessible justifiers; (2) to obtain a more in-depth insight into the structure of epistemic actions. In particular, implicit knowledge of A can be further analyzed as the current availability of the means for constructing a dependable justification of A.

References: Artemov 2008. The Logic of Justification. Review of Symbolic Logic, 1: 477-513. Duc 1995. Logical Omniscience vs. Logical Ignorance on a Dilemma of Epistemic Logic. LNCS 990, pp. 237-248, Berlin: Springer. Fitting (2005). The logic of proofs, semantically. Annals of Pure and Applied Logic, 132: 1-25. van Ditmarsch et al. 2006. Dynamic Epistemic Logic, Dortrecht: Springer. van Benthem 2011. Logical Dynamics of Information and Interaction, Cambridge: CUP.

Intentional identity in epistemic logic

Tanninen Tuukka
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P. Geach (1967, 628) introduced the sentence “Hob thinks a witch has blighted Bob’s mare, and Nob wonders whether she (the same witch) has killed Cob’s sow”, and called for a formalization fulfilling the following conditions: (i) No existentially committing de re constructions (to avoid ontological commitment to witches); (ii) No specifying de re constructions (to keep the object term ‘a witch’ indefinite); (iii) no iteration of epistemic operators (to avoid thoughts about thoughts); (iv) variable-binding across the sentential connective (to model the anaphoric link between ‘a witch’ and ‘she’). In this survey I briefly evaluate the efforts to formalize this sentence in the Hintikka-style quantified epistemic logic. Five proposals by seven writers have been put forth in print: three game-theoretical and two employing the so-called world-line method introduced in Hintikka (1969). Surprisingly the writers do not refer to one another and hence there has been no proper debate over the matter. Hintikka (1974, 104 & fn. 9) notes briefly that the key to the correct formalization is to deal with “ill behaving world-lines”. In Hintikka’s system world-lines are functions from epistemically possible worlds to extensions and they provide individuals for quantifiers to range over. Their “ill-behavior” in this case is that they fail to pick out individuals from the actual world. These remarks imply the following simple formalization *(Ex) (THOB B(x) & WNOB K(x)) in which Ex is a perspectival quantifier introduced in Hintikka (1969). It is, among other things, a device to distinguish reporter’s ontology from the agents’ ontology. The subsequent writers have developed considerably more complex formalizations than * but I argue that * is nevertheless the most promising due to its elegance. * violates (ii) to some extent but all the subsequent solutions also either violate (i) (iv) or reduce to *

An analysis of the problem of logical omniscience of epistemic logic

Wang Ren-June
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Epistemic logic as an important tool for reasoning about an intellectual agent's epistemic states has suffered from the so-called logical omniscience problem since the beginning of its introduction. The problem indicates an idealized assumption on the part of the agent presented by a formalism of such kind. Although alternative epistemic formalisms have been proposed for dealing with the problem, there is no sight of that the problem is settled. Thus in this talk I will try my hand firstly to give an analysis of the problem, hopefully to pin down the source of the problem, and then accordingly provide an advice as what is the right direction of solving the problem. The analysis shows that there are three aspects that we expect that a designed epistemic formalism can meet at once. Firstly, epistemic logic must deal with explicit knowledge, the knowledge that the reasoned agent can use in his/her decision making process. Secondly, the formalism should be able to reflect the intelligent agent's reasoning ability; that is, the agent is supposed to be able to increase his knowledge by performing deductive reasoning. Finally, the agent, though intelligent, can't be logical omniscient and hence explicitly knowing all the consequences that the agent's reasoning ability will lead him to know. However, these three aspects can't be woven together seamlessly in the epistemic formalisms of the traditional way. And hence in this talk I will suggest that in order to incorporate the three aspects, what we need is not a formalism with a machinery that can limit what is known by the agent, but one with more powerful expressivity such that

the resource that an agent will consume in the course of his/her reasoning, such as the temporal duration, can be explicitly stated.

A2.12 PHILOSOPHICAL LOGIC

Thursday, August 6 • 17:00–19:00
Main Building, Room 15

Generalized Dialetheism and Curry's Paradox

Caret Colin
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Dialetheism is the view that the premises and inferences of paradoxical arguments should be accepted, full stop. In paradigm cases this carries a commitment to outright inconsistency, e.g. the claim that the Liar sentence is true and the claim that the Liar sentence is false. According to the dialetheist, we ought to accept such inconsistent claims while `isolating' them from the rest of our discourse by adopting a paraconsistent logic. This strategy generalizes neatly to a host of famous paradoxes including Russell's paradox, Grelling's paradox, and the Knowability paradox. There is, however, a fly in the ointment: Curry's paradox. The premises and inferences of a Curry-paradoxical argument seem to be flatly unacceptable because they carry directly incoherent commitments. For example, consider a Curry sentence, such as the sentence K as follows: "If K is true, everything is true." By the disquotational role of truth and the rule of contraction, we can infer that K is true, which carries a commitment to the incoherent claim that everything is true. It seems that solving this paradox requires that we reject one of the premises or inferences involved in this argument. Curry's paradox, thus, has the dubious honor of being insoluble by dialetheic methods. Many consider this to be the single, greatest weakness of dialetheism, as it dashes any hope of a unified dialetheic solution to the paradoxes. (See, e.g., Goodship (1996) and Whittle (2004) on the challenge to dialetheism from taking a fragmented approach to paradox) In this paper, I argue that the critics are wrong: there is a coherent generalization of the dialetheic perspective that circumvents the problem above. The key is to restrict structural contraction in the context of reasoning with such concepts as truth and membership. I show how the Liar and Curry's paradox are amenable to the same type of solution once this restriction is in place.

Graphs, naive truth, and well-behaved conditionals

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Many philosophers and logicians are interested in the so-called "naive" notion of truth, which can be roughly described as follows: every declarative sentence "A" of a language L is equivalent to " 'A' is true", for some notion of equivalence, where " 'A' is true" is also a sentence of L. In this paper, I discuss the theories of naive truth developed by Kripke and Field and I address "Field's challenge", a research project aimed at adding a well-behaved conditional connective to Kripke's theory of truth. To this aim, I develop a semantics based on some graph-theoretical intuitions and tools. The resulting model shows that Field's challenge can be met respecting some natural criteria on the characterization of the logical constants (including the conditional), criteria which arguably are not met by Field's theories. At the same time, this construction contributes to the semantics of naive truth with some specific results, e.g.: (i) natural partial versions of every Lukasiewicz semantics are proven consistent and omega-consistent with naive truth (non-partial versions of finitely valued Lukasiewicz semantics are inconsistent with naive truth, and the continuum valued one is omega-inconsistent with it); (ii) a unique operator for "determinateness" can be defined that applies to every sentence receiving a truth-value, possibly including the determinateness operator itself, consistently with naive truth. Such operator avoids revenge paradoxes and is strikingly simple. Such a strong operator is unavailable in Kripke's setting and inconsistent with Field's theory. Finally, I show how the semantics proposed here allows us to make some new distinctions between semantic paradoxes that are usually conflated together, accounting for the differences between liar-like paradoxes, Curry- like paradoxes, truth-teller-like paradoxes, McGee-like paradoxes, Yablo- like paradoxes and more.

Saving tolerance from paradox; a game semantics for tolerance

Abasnezhad Ali
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Saving tolerance from paradox; a game semantics for tolerance Tolerance principles – such as "anyone who is 1cm shorter than a tall man is tall, too" – are highly intuitive. Dominant theories of vagueness, however, argue against the consistency of tolerance on the basis that these principles generate sorites paradoxes. In reaction, there are two comprehensive works on how to save tolerance from paradox: Zardini (2008) and van Rooij (2010). In the first part of this paper we argue that neither theory succeeds. We raise a common objection against them: Both theories are based on a model-theoretic semantics with a non-standard definition for validity. By model- theoretic semantics we mean a semantics which is based on assigning a cluster of sets of objects to any predicate. It is argued that in all model-theoretic semantics there exists sharp boundary for each predicate F in the sense that there are two adjacent objects in the relevant soritical chain that one of them is F and it is not the case that the other is F. It is argued also that existence of sharp boundary entails that the relevant tolerance principle is not true. Consequently, both theories falsify tolerance. Besides this common objection there is a distinctive objection against van Rooij's theory. Van Rooij's theory has more than one notion of validity and it validates tolerance just in the weakest sense. This consequence assimilates the theory with dominant theories of vagueness which falsify tolerance but satisfy a weaker version of it. In the second part of the paper we propose that in order to save tolerance from paradox a more deviation from classical semantics is to be appealed. We propose that one should abandon the picture of language as a representator of something else. Instead the picture of language as a rule governed activity (game) is more tenable for the sake of modeling tolerance. We first consider concrete examples of tolerant predicates and then abstract general rules from them. The most important rule is: In general, whenever "a is F" is assertible, a is close enough to b, b is close enough to c and there is a tolerance principle at hand, it is assertible that b is F too, but it is not warranted to assert that c is F. This rule mandates 1) that the logic of tolerance should not be transitive; and 2) that there are levels of warranted assertion: plain assertion (including asserting Fa when a is a paradigm case of F) and weak assertion (including asserting Fb in the above mentioned rule); and 3) that sometimes argumentation play role in applying tolerant predicate to something. We then introduce a semantic for non-transitive logic in the category of game semantics (namely what is known as dialogical semantics). According to the proposed semantics there are levels of assertion and there are some strategic rules governing how and when the levels of assertion change. These rules in the formal semantics are parallel to the rules which are abstracted from the concrete examples. A valuable feature of the proposed semantics is that it does not change the definition of validity. At the end of the paper we argue that the formal semantics introduced is not suffered from the sharp boundary objection. Indeed, the semantics resolves the problem, since (despite model-theoretic semantics) there is no extension for predicates that has or does not have sharp boundary.

A Revision-Theoretic Supervaluational Theory of Truth

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Many semantic approaches to the Liar paradox and self-referential truth fall under one of two major paradigms: Kripke's Outline of a theory of truth (1975) and The revision theory of truth, the latter introduced by Herzberger and Gupta, independently, in 1982. Both approaches are instantiated in the literature by a copious variety of proposals, however some distinctive mathematical features typifyi ng them can be easily identifi ed.

A Kripke-style approach is characterised by a monotonic operator (called a "jump" operator) on partial interpretations for a truth-predicate. A revision-theoretic approach, on the other hand, is characterised by a collection of ordinal-length iterations of an operator (called the "revision" operator) de fined on total interpretations of the truth-predicate. One way of mathematically contrasting the two approaches is through the notions of groundedness and stability: a sentence is "grounded" if it belongs to the least fi xed point of the jump operator, while it is "stable" if it eventually receives the same truth value in all revision iterations. The formalisation of revision through trans finite iterations has to face with the problem of what to do at limit stages. Further, the resulting theory has a degree of mathematical and logical complexity which is scarcely compatible with the purpose of simply finding a predicate of sentences for expressing fi rst-order truth.

In my talk I will present a fresh proposal, called Revision-theoretic supervaluation, which aims to preserve the fundamental insights and goals of revision but, formally, working in a Kripke-style framework. I will present my proposal in some details and I will sketch the proofs of some result connecting it with Kripke's theory when the jump operator is defi ned by using van Fraassen's supervaluation. The presentation is intended to stimulate a discussion about to what extent this mathematical construction can capture the philosophical content of revision.

A2.13 PHILOSOPHICAL LOGIC

Thursday, August 6 • 14:30–16:30
Main Building, Room 14

The Liar-like paradoxes

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Assume the sentence (1) (1) is false. The sentence (1) immediately leads to the Liar paradox, because it is easily to demonstrate that (1) is true if and only if (1) is false (not true). The T-scheme, that is the formula "A is true if and only if A" is essential for generating the paradox in question. The paper shows that we can formulate other the Liar-like paradoxes, in particular, the verifiliabiity or analyticity paradox: (2) (2) is verifiable; (3) (3) is not analytic. These paardoxes are the Liar-like because they essentially depend on self-referentiality. Note, however, that that self-referentiality has the semantic character (it uses, directly or indirectly the T-scheme), but not consists in attributing to sentences non-semantic properties, for instance, "(1) is not written in italic". Accordingly, the Tarski-Lesniewski way out is based on a deep observation of how semantic machinery works.

Fuzzy Logic and Sorites Paradox: The Problem of Missing Input

Štepánek Jan
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Sorites paradoxes are a class of paradoxical arguments which arise as a result of using vague terms such as "heap", "bald", or "tall". Vague terms, in contrast with precise terms, lack precise boundaries of application. There are objects to which a) the vague term applies, b) the vague term does not apply, and c) it is uncertain whether vague term applies or not (so called borderline cases). In borderline cases it is uncertain whether the vague term in question applies to them or not. Moreover, this uncertainty cannot be resolved by any enquiry. When we are asked whether some person is tall, we take only his height into consideration. When said person measures 150 centimetres, we are inclined to say that the person in not tall. When that person measures 220 centimetres, we would not hesitate calling that person tall. We, however, would not be so sure about a person measuring 184 centimetres. Yet we would be sure that a person measuring 190 centimetres is taller than a person measuring 185 centimetres. It seems that being tall is a matter of degree. At least proponents of fuzzy logic would say so. Sentences like "X is tall" can therefore have different truth value ranging from 1 – absolutely true – to 0 – absolutely false – according to X's height. "X is tall" can have truth value of 0.48571 for X measuring 184 centimetres and truth value of 0.57143 for X measuring 190 centimetres. In the case of sorites paradox, at least one of its premises has an intermediate truth value and its consequence therefore cannot be absolutely true (or absolutely false). In my talk I am going to examine some of the problems that fuzzy logic faces when dealing with sorites paradoxes. I am going to point out that fuzzy logic can only be applied when certain class of vague terms is used to formulate sorites paradox, while it cannot be applied when the rest of vague terms is used. Furthermore, I am going to show that even in cases in which fuzzy logic can be employed, it presupposes another solution to sorites paradox and it therefore cannot be counted as a solution itself.

Some Remarks on the Cassationist Approach to the Liar Paradox

Valor Abad Jordi
Lògica i Filosofia de la Ciència, Universitat de València, Valencia, SPAIN

The evaluation of any utterance of the sentence 'L is false', where the content of 'L' is fixed by the stipulation: L =df 'L is false', gives rise to the Liar Paradox. By appealing to intuitive principles about truth –such as Tarski's Schema– we can easily see that L is true if and only if L is false. The cassationist approach to the Liar uses this fact in order to offer a reductio of the idea that L can successfully be used to express propositions or advance statements which we can then evaluate as true or false. As it happens with any other alleged solution to the Liar paradox, the cassationist approach should ideally meet some requirements: (a) not being ad hoc (actually explaining why our utterances of L fail to have content); (b) being general enough (explaining why different versions of the Liar –in particular, contingent Liar paradoxes ('Cretans always speak falsely'), and paradoxes that involve indexicals in their formulation ('This is false')– are semantically defective); (c) being free from paradoxes (not generating paradoxes of its own). Goldstein, and more recently Rosenkranz and Sarkohi, have defended the cassationist view on the grounds that stipulations such as that fixing the meaning of 'L' or such as S =df 'S is not true' –which gives raise to the most popular version of the strengthened liar paradox– are defective. They also consider different versions of the liar paradox and other paradoxes of self-reference. In this presentation I will examine to what extent their proposals are free from paradoxes and will raise some questions as to how we are to understand the semantic defectiveness of the above stipulations and the meaning of the singular terms appearing in them: 'L' and 'S'.

A Conditional for Vagueness and the Liar

Oms Sergi
Lògica, Història i Filosofia de la Ciència, Logos, University of Barcelona, Barcelona, SPAIN

I want to present a three-valued paracomplete logic, based on the work of Hartry Field, that captures in a reasonably intuitive way how we reason under the phenomenon of vagueness in languages with a truth predicate. I claim that this is a first step towards a satisfactory logic for the Vagueness and Liar-like paradoxes where the naive theory of truth can be implemented; that is, where we can have the Intersubstitutivity Principle (IP):

> If two sentences A and B are alike except that one has a sentence C where the other has $T\ulcorner C\urcorner$, then $A \models B$ and $B \models A$.

I will use a language $\mathcal{L}$ suitable to express canonical names for its own sentences and I will extend it to a new language, $\mathcal{L}^+$, with a truth predicate, Tr. I will use models with a set W of three valued points and create a process of revision where each point is enlarged to a Kripke fixed point. The conditonals I will use will be of the following form:

$$| A \Rightarrow B |_{u,\alpha,\sigma} = \begin{cases} 1 \text{ iff } (\exists\beta < \alpha)(\forall\gamma \in [\beta,\alpha))(\forall w \in W \text{ such that } u \leq w), \\ \quad \text{if } \ | A |_{w,\gamma,\Omega} = 1 \text{ then } \ | B |_{w,\gamma,\Omega} = 1 \\ 0 \text{ iff } (\exists\beta < \alpha)(\forall\gamma \in [\beta,\alpha)), | A |_{u,\gamma,\Omega} = 1 \text{ and } \ | B |_{u,\gamma,\Omega} = 0 \\ 1/2 \text{ otherwise} \end{cases}$$

Where u is a point in the model, α is a stage on the revision process and σ is the Kripke fixed point for the truth predicate in α.

A2.14 PHILOSOPHICAL LOGIC

Thursday, August 6 • 14:30–16:30
Main Building, Room 15

Modal Logics of Abstract Explanation Frameworks

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Halas Juraj
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A common feature of the many theoretical accounts of scientific explanation is that explanation is taken to be a relation between the explanandum and the explanans: the explanans explains the explanandum. However, with a few notable exceptions, the topic of explanation has scarcely been explored from the abstract point of view of the explanation relation and its relata. In this talk, we discuss the possibility and merits of such an approach and develop formal tools for reasoning about explanations on an abstract level. Firstly, simple explanation frameworks are introduced as a representation of the core structure of explanation. Simple explanation frameworks are directed graphs where an edge between x and y represents the assumption that x explains y. Secondly, a multi-dimensional version of simple explanation frameworks, called abstract explanation frameworks, is discussed. The multiplicity of dimensions (`kinds of edges') represents the multiplicity of criteria for admissibility of explanations. Thirdly, a multi-dimensional normal modal logic for reasoning about such structures is introduced. The logic uses a temporal language with `forward' and `backward-looking' modalities, but interpreted in terms of explanation. Several applications of this formalism to formalizing specific explanation-scenarios are discussed. Finally, a non-classical modal logic for reasoning about `strong negation' in the context of explanation is briefly discussed.

The Import of Formal Logic with Respect to Knowledge – The Fundamental Question of the "Critique of Pure Reason"

Gottschlich Max
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Engaging with Kant's transcendental logic seems to be a question of mere scholarly historical interest today. It is most commonly regarded a strange mixture between logic and psychology or epistemology, and by that, not a serious form of logic. Transcendental logic seems to be of no systematical impact on the concept of logic. My paper aims to disclose a different account on the endeavour of Kant's transcendental logic in particular and of the "Critique of Pure Reason" (CPR) in general. Kant's fundamental question is in a revolutionary way aiming to ground the character of necessity of knowledge, which means to justify the claim that thinking in accordance with the forms and principles of formal logic does not lead to sheer tautologies or an unsolved contradiction, but to knowledge that is objectively valid. I shall proceed in three steps:

In a first part, I shall demonstrate the necessity and the significance of this new fundamental question of the CPR with respect to its genesis out of pre-Kantian metaphysics. This question will lead to a consistent way of understanding the determinations that are unfolded in the CPR, which differs from the prevailing readings. A second part shall give a brief outline of Kant's answer to this question, with special emphasis on his revolutionary new comprehension of logical form.

A third part will answer the question: What knowledge do we achieve about being or actuality by means of formal logic? I will argue that Kant shows (a) that formal logic is the logic of all technical-practical conduct but also, at least indirectly, (b) the limitation of the technical-practical knowledge and its legitimate sphere of application.

The Rules of Definition: a Logical and Pragmatic Perspective

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We offer a formulation of a set of rules for definitions that is informed by modern logic and pragmatics. We aim to be as precise as possible in formulating the extensional, intensional and pragmatic features of each rule. We discuss a set of rules that derives from Aristotle's treatise on the art of dialectic, Topics. The concern with logical requirements for definitions can be traced back at least to Socrates as represented in Plato's early dialogues. From our standpoint, the rules of definition belong to scientific methodology but also to the pragmatics of argumentative practices. Our prescriptions for definitional practices try to steer clear from controversial issues in semantics. We point out some philosophical difficulties in our minimalist program as we proceed. We will proceed as follows: First, we will distinguish three components in a definition rule: a principle, a criterion and a motivation. Secondly, we discuss the logical form of definition sentences and the properties of the relation "… =df …". Thirdly, we account for six classical rules, highlighting the components for each rule. The rules address issues about extensional equality, essential predication, circularity, negative definitions, synonymous expressions and metaphorical language. Our formulation will make it apparent that the principles of definition are either logical requirements or pragmatic rules, and we will insist on the importance of the latter.

First steps towards non-classical logic of informal provability

Pawlowski Pawel
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Mathematicians prove theorems. They don't do that in any particular axiomatic system. Rather, they reason in a semi-formal setting, providing what we'll call informal proofs. There are quite a few reasons not to reduce informal provability to formal provability within some appropriate axiomatic theory (Marfori, 2010; Leitgeb, 2009). The main worry about identifying informal provability with formal provability starts with the following observation. We have a strong intuition that whatever is informally

provable is true. Thus, we are committed to all instances of the so-called reflection schema P (φ) → φ (where φ is the number coding formula φ and P is the informal provability predicate). Yet, not all such instances for formal provability (in standard Peano Arithmetic, henceforth PA) are provable in PA. Even worse, a sufficiently strong arithmetical theory T resulting from adding to PA (or any sufficiently strong arithmetic) all instances of the reflection schema for provability in T will be inconsistent (assuming derivability conditions for provability in T are provable in T). Thus, something else has to be done. The main idea behind most of the current approaches (Shapiro, 1985; Horsten, 1994, 1996) is to extend the language with a new informal provability predicate or operator, and include all instances of the reflection schema for it. Contradiction is avoided at the price of dropping one of the derivability conditions. Thus, various options regarding trade-offs between various principles which all seem convincing are studied. In order to overcome some of the resulting difficulties and arbitrariness we investigate the strategy which changes the underlying logic and treats informal provability as a partial notion, just like Kripke's theory of truth (Kripke, 1975) treats truth as a partial notion (one that clearly applies to some sentences, clearly doesn't apply to some other sentences, but is undecided about the remaining ones). The intuition is that at a given stage, certain claims are clearly informally provable, some are clearly informaly disprovable, whereas the status of the remaining ones is undecided. In Kripke-style truth theories strong Kleene three-valued logic is usually used – which seems adequate for interpreting truth as a partial notion. Yet, we will argue that no well-known three-valued logic can do a similar job for informal provability. The main reason is that the value of a complex formula in those logics is always a function of the values of its components. This fails to capture the fact that, for instance, some informally provable disjunctions of mathematical claims have informally provable disjuncts, while some other don't. We develop a non-functional many-valued logic which avoids this problem and captures our intuitions about informal provability. The logic is inspired by paraconsistent logic CLuN (see e.g. Diderik Batens, 2004), in whose standard semantics the value of a negation is not determined by the value of its argument. We describe the semantics of our logic and some of its properties. We argue that it does a much better job when it comes to reasoning with informal provability predicate in formalized theories built over arithmetic.

References Diderik Batens, K. D. C. (2004). A rich paraconsistent extension of full positive logic. Logique et Analyse, 185- 188. Horsten, L. (1994). Modal-epistemic variants of Shapiro's system of epistemic arithmetic. Notre Dame Journal of Formal Logic, 35(2):284–291. Horsten, L. (1996). Reflecting in epistemic arithemtic. The Journal of Symbolic Logic, 61:788–801. Kripke, S. A. (1975). Outline of a theory of truth. Journal of Philosophy, 72(19):690–716. Leitgeb, H. (2009). On formal and informal provability. In New Waves in Philosophy of Mathematics, pages 263–299. New York: Palgrave Macmillan. Marfori, M. A. (2010). Informal proofs and mathematical rigour. Studia Logica, 96:261–272. Shapiro, S. (1985). Epistemic and intuitionistic arithemtic. In Intensional mathematics. North Holland.

A2.15 PHILOSOPHICAL LOGIC

Thursday, August 6 • 17:00–19:00
Main Building, Room 12

Elementary deductive step and Church's Thesis

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Recent description by S. Kripke of Church's thesis as a corollary Godel's completeness theorem must be supplied by analysis of the notion of elementary deductive step. This in turn implies some epistemological problems concerning Church thesis.

As far as the mathematical reasoning is supposed to be a cognitive act, the understanding of it is result of some kind of "insight". On the other hand, the formal proof can be represented as a calculation. The latter is performed by some mechanical devise. In this case we cannot ascribe to the mathematical reasoning only cognitive status.

Having in mind the double nature of proof we have to look for the common point of cognitive act and deductive reasoning. Such "meeting point" must be elementary deductive step which is both persuasive mental act and mechanical calculation. Otherwise it is difficult to understand how to reconcile these two characteristics in long piece of reasoning.

The very notion of "elementary" transition from one string to another according to some rule is relative to formal system. The effective partitioning of formal reasoning into elementary steps through mechanical calculation should not coincide with the same partitioning in cognitive process. It is not clearly that we could expect close correlation between them.

In this case can we assert that Church's thesis is concerned only with calculative aspect of deductive reasoning related to mechanical actions? May be we need some modification of the thesis that would take into account the explication of the notion of elementary deductive step.

The Iterated Prisoner's Dilemma as an Interrogative Game

Zerpa Levis
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In this communication, the iterated Prisoner's Dilemma (? PD) from game theory and several decision rules proposed to solve this dilemma in Axelrod's computer tournaments (Axelrod 1984) are reconstructed as a family of interrogative games in Professor Hintikka's sense (Hintikka 1999, Genot & Gulz 2013). This family of interrogative games are called the Interrogative Prisoner's Dilemma (? IPD). The main idea behind the IPD is the following. The setting of the (classical) PD provides the theoretical premises and the presupposition of the "big" or principal deliberative question to be answered through the IPD. Tautologies in the Player's range of attention (RA) provide the presuppositions of a set of basic yes-no questions posed at the beginning of the game. These yes-no questions as well as further auxiliary questions forms the set of operative (or "small") questions of the IPD. Then, the process of answering these operative questions allows the player to generate or discover, in a step-by-step fashion, the many decision rules proposed in Axelrod's tournament. More specifically, decision rules as TIT FOR TAT, TIT FOR TWO TATS, DOWNING, FRIEDMAN, and others are all generated, by strategic analysis, as conclusive answers (in Hintikka's sense) to the main deliberative question of the IPD.

This result provides evidence of the thesis that interrogative logic is a major component of a theory of scientific discovery and a path to innovation and this fact is reflected in the way in which the decision rues are generated or discovered as answers to questions posed in the IPD. In fact, other decision rules not mentioned in Axelrod's text are also generated by questioning in the IPD. Consequences of this result for the philosophy of economics and the science and technology studies are also explored in the paper.

A qualitative perspective on vagueness and degrees of truth

Marrano Rossella
Philosophy, Scuola Normale Superiore, Pisa, ITALY

One of the primary goal of infinite-valued logics is to model reasoning under vagueness. On such an approach, sentences are assigned as truth-value a real number between 0 (absolute falsehood) and 1 (absolute truth). The degree-theoretic account of vagueness has been the object of longstanding criticisms. In particular, it has been argued that the assignment of a unique real number as truth-value imposes a precision which is unacceptable for sentences involving vague predicates. This argument is known as *artificial precision objection.*

The main contribution of this paper is to argue that this and related difficulties can be overcome by adopting a qualitative perspective on modelling degrees of truth. The key step consists in shifting the focus from the point-wise evaluation of sentences to the binary comparison of their truth-values.

In order to have a better grasp on this, let $\mathcal{SL}$ be a propositional language and consider Łukasiewicz real-valued logic with its standard truth-value semantics. This paper puts forward an alternative semantics based on a binary relation on the set of sentences $\preceq \subseteq \mathcal{SL} \times \mathcal{SL}$ interpreted as "no more true than". We then lay down sufficient conditions for this relation to represent a valuation in Łukasiewicz logic. More precisely, we put forward an axiomatisation of $\preceq$ so that there exists a Łukasiewicz valuation $v\colon \mathcal{SL} \to [0,1]$ such that for all $\theta, \phi \in \mathcal{SL}$

$$\theta \preceq \phi \Leftrightarrow v(\theta) \leq v(\phi).$$

This result sets the conditions under which a quantitative evaluation arises from qualitative comparisons. In virtue of this, the commitment to a unique numerical assignment for sentences is shown not to be necessary, so that the objection of the artificial precision loses much of its force.

The inapplicability of (selected) paraconsistent logics

Urbaniak Rafal
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In some cases one is provided with inconsistent information and has to reason about various consistent scenarios contained in that information, assuming no inconsistency is actually true. Our goal is to argue that the so-called filtered paraconsistent logics are not the right tool to handle such cases and that the problems generalize to a large class of paraconsistent logics.

A wide class of paraconsistent (inconsistency-tolerant) logics is obtained by filtration: adding conditions on the classical consequence oper- ation (one example is weak Rescher-Manor consequence: φ is such consequence of Γ just in case φ follows classically from at least one maximally consistent subset of Γ). We start with surveying the most promising candidates and comparing their strength. Then we discuss the mainstream views on how non-classical logics should be chosen for an application and argue that none of these allows us to chose any of the filtered logics for action-guiding reasoning with inconsistent information, roughly because such a reasoning has to start with selecting possible scenarios and such a process does not correspond to any of the mathematical models offered by filtered paraconsistent logics. Finally, we criticize a recent attempt to defend explorative hypothetical reasoning by means of weak Rescher-Manor consequence operation by Meheus, Straßer, and Verd'ee (2014).

References: Meheus, J., Straßer, C., & Verd'ee, P. (2014). Which style of reasoning to choose in the face of conflicting information? Journal of Logic and Computation. ((in print))

A2.16 PHILOSOPHICAL LOGIC

Saturday, August 8 • 13:30–15:30
Main Building, Room 8

On Search for Law-Like Statements as Abductive Hypotheses by Socratic Transformations

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Wisniewski Andrzej
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We define a mechanism by which abductive hypotheses having the form of law-like statements (LLSs) are generated. We use the Socratic transformations (ST) method as the underlying proof method, which itself is grounded in the Inferential Erotetic Logic. The ST method offers a formal explication of the idea of solving logical problems of entailment or derivability by pure questioning, that is, by transforming the relevant initial question into consecutive questions without making any use of answers to the questions just transformed.

Our approach to abduction fits into the algorithmic perspective proposed by Gabbay and Woods, according to which an abductive hypothesis H "is legitimately dischargeable to the extent to which it makes it possible to prove (or compute) from a database a formula not provable (or computable) from it as it is currently structured".

In order to compute abductive hypotheses in the form of LLSs we augment the calculus EPQ (which is an erotetic counterpart to the pure FOL) with a rule generating so-called proto-abducibles. Then we show how on this basis LLSs can be derived, depending on the distribution of parameters in the antecedent and the consequent of a given proto-abducible. We prove that LLSs so obtained have the desired properties of abductive hypotheses. We show also how to compute such hypotheses in the case of applied FOL. Finally, we address some issues concerning heuristics of such computations.

An adaptive logic for the abduction of minimal explanations

Van De Putte Frederik
Philosophy and Moral Science, Ghent University, Gent, BELGIUM

Echoing (and simplifying) Peirce's famous dictum [6], abduction may be defined as any inference that falls under the following schema:

(P1) C is the case. (P2) If A would hold, then C would be a matter of fact. ------------------------- ------------------------------ (C) A is the case.

In adaptive logics of abduction [5, 4, 3, 2, 1], abductive inferences are validated in a context-specific, defeasible way. The aim of these logics is to provide a formal (proof-theoretic) explication of the process of explanation-seeking. In these logics, (P2) is usually taken to be a generalization or background law.

This talk will consist of three parts. First, I will show that the existing candidates for such logics (and slight variations thereof) face several problems, and hence fail to accomplish their alleged aim. Second, I will distinguish two types of complications for the development of a decent logic of abduction. Finally, I will propose two concrete ways to cope with those complications independently, and show how this allows us to de ne a single, well-behaved adaptive logic that validates abductive inferences.

References: [1] Mathieu Beirlaen and Atocha Aliseda. A conditional logic for abduction. Synthese, 191(15):3733-3758, 2014. [2] Tjerk Gauderis. Modelling abduction in science by means of a modal adaptive logic. Foundations of Science, 18(4):611-624, 2013. [3] Hans Lycke. A formal explication of the search for explanations: The adaptive logics approach to abductive reasoning. Logic Journal of the IGPL, 20(2):497-516, 2011. [4] Joke Meheus. A formal logic for the abduction of singular hypotheses, volume 2 (1) of Explanation, prediction, and con rmation, pages 93-108. Springer, 2011. [5] Joke Meheus and Diderik Batens. A formal logic for abductive reasoning. Logic Journal of the IGPL, 14:221- 236, 2006. [6] Charles S. Peirce. Collected Papers. Harvard University Press, Cambridge, Massachusetts, 1958-60.

An Adaptive Approach to Frege's Set Theory

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Frege's set theory is (FST) interesting for adaptive logics in two respects. (1) The reason for devising inconsistency-adaptive logics was precisely to handle theories that were meant to be consistent but turned out inconsistent and hence, if taken literally, trivial. Inconsistency-adaptive logics should locate the inconsistencies in such a theory and isolate them. The result should be a useful preparatory step for developing a consistent alternative for the inconsistent theory. (2) The ideas behind FST are very natural. So it seems attractive to delineate the inconsistent theory itself. This should be non-trivial but nevertheless have the full richness intended by Frege. The only possible way to realize this is in terms of an inconsistency-adaptive logic.

The lecture will concern (2) but the insights presented will be directly relevant for (1) as well. An adaptive FST, or rather several such theories, will be elaborated. I shall briefly refer to adaptive FSTs forged by Peter Verdée, which restrict the notion of a set, allowing only for sets that are grounded (in a specific sense). That they depart in their non-logical axioms from Frege's is a good reason to look for alternatives.

The crucial tenet will be that the desired theories cannot be obtained by a general and a priori method, but requires a content-guided procedure in the sense of Shapere. The specific problem solving process will be described. It will enable me to tell a concrete and detailed story, going through a sequence of choices restricted by the theory under development. The story will clarify my philosophical position on logical pluralism.

The lecture concerns philosophical logic rather than foundations of set theory because it aims at propagating a certain type of logics (actually formal characterizations of methods) and at clarifying their application in vivo.

A2.17 PHILOSOPHICAL LOGIC

Friday, August 7 • 11:00–13:00
Main Building, Room 10

Anderson and Belnap's Confusion

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Anderson and Belnap, in their otherwise very thorough grammatical appendix to volume 1 of their book 'Entailment', knew that they were treading on shaky ground. For they wanted to make it philosophically respectable, they said, to 'confuse' two things. Their attempt was to 'make it philosophically respectable to "confuse" implication or entailment with the conditional'. But there are other cases they needed to consider besides the ones they did which show that they definitely created confusion, thereby failing to make the matter 'philosophically respectable.' Clarifying the matter has a number of significant consequences not only for their work on Entailment, but also for the Relevance Logic tradition and indeed standard propositional logic quite generally.

Metalogical Decorations of Logical Diagrams

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Smessaert Hans
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In the last few decades, the classical square of oppositions has been extended to larger diagrams such as hexagons and cubes, and applied to various contemporary logical systems such as modal logic. Recently, logicians have also started using Aristotelian diagrams to visualize the relations between metalogical notions such as tautology and consistency. In this presentation, we will extend this line of work and provide a unifying perspective on the existing results. Next to the set of Aristotelian relations, we define three other sets of logical relations, viz. opposition, implication and duality relations.

It can be shown that every pair of formulas stands in exactly one of the four opposition relations, viz. contradiction (CD), contrariety (C), subcontrariety (SC) and non-contradiction (NCD). Hence, they constitute a quadripartition of logical space, whose powerset consists of 2^4 = 16 elements, and can be visualized by means of a three-dimensional rhombic dodecahedron (RDH). This diagram is significantly larger than the metalogical hexagons studied so far, and moreover, turns out to contain many of them as subdiagrams. For example, several authors distinguish between 'strong' and 'weak' senses of contrariety, which correspond to C and C v CD, respectively. We can define a second 'weak' sense of contrariety, viz. as C v NCD, and prove it to be dual to the first (in the sense that two formulas are in C v CD iff their negations are not in C v NCD). The Aristotelian and duality relations between these various senses of contrariety can be visualized by means of octagons, which are subdiagrams of RDH (see Figures 1 and 2).

Since implication is a partial order, we can construct a second metalogical RDH for the implication relations. This stands in sharp contrast to the well-known hexagon for the arithmetical ordering between numbers, which is a total order.

Notions of relevance for classical logic.

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In a sense, all logics should be relevance logics. After all, since ancient times, lack of relevance between premisses and conclusions has been considered a logical defect and not only a rhetorical shortcoming. Of course, some logical systems, including classical logic, have prominently failed to have some types of relevance, such as variable-sharing. On top of that, the very notion of relevance is notoriously difficult to make precise if we want to avoid psychological overtones. Because of this, some logicians have postulated that relevance, at least in some versions of the notion, is not a necessary condition for logical correctness. Yet, there are strong reasons to try to find for each notion of logical correctness at least one notion of logical relevance, and to distinguish such a notion from related notions of a more psychological nature. This paper builds on seminal work on the semantic content of declarative propositions and reviews some informational notions of relevance exhibited by several important logical systems, including good ol' classical logic itself. This shows that in those cases and at least in some very precise senses of relevance, our age-old intuitions could be satisfied.

On the Multiple Advantages of a Certain Uniform Framework for Consequence

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Blasio Carolina
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One way of semantically characterizing the received notion of logical conse- quence [A. Tarski, D. Scott] is by way of certain distinguished truth-values being preserved from the set A of sentences taken as premises to the set B of sentences taken as alternative conclusions. This can also be framed in terms of the incom- patibility between the attitudes involved in accepting A while simultaneously not accepting B; equivalently, it may be put in tems of the incompatibility between rejecting B while not rejecting A. Capitalizing on the assumed con- tradictory opposition between acceptance and rejection, one may then argue that logics are in fact two-valued [R. Suszko], and insisting on the bipolarity of attitudes one may argue that standard logics are, after all, mono-valued [Y. Shramko–H. Wansing].

Heterodox approaches to consequence often proceed by generalizing the stan- dard approach in allowing acceptance and rejection to be independent attitudes, thus preventing the coincidences between acceptance and nonrejection, and be- tween rejection and nonacceptance. In that respect, one well-explored alterna- tive is the notion of q-entailment [G. Malinowski], according to which nonaccep- tance is allowed to intersect nonrejection, and B is said to follow from A when it is incompatible to nonaccept A while simultaneously nonrejecting B. Dually, according to the notion of p-entailment [S. Frankowski], acceptance may inter- sect rejection, and B is said to follow from A when it is incompatible to accept A while simultaneously rejecting B. If one strives to characterize such heterodox notions of entailment according to the Tarskian framework, it will appear that standard properties of consequence (such as extensiveness, or cut) fail. How- ever, using a framework that allows for independent collections of distinguished truth-values, all the above notions are easily seen to be particular examples of a more general four-place entailment [A. Bochman]. In our contribution we will show how such uniform framework connects to modern reconstructions of the square of oppositions, to bilattice-based reasoning, and to nondeterministic semantics.

A2.18 PHILOSOPHICAL LOGIC

Friday, August 7 • 11:00 –13:00
Main Building, Room 15

Two Faces of Logical Truths --- Between Ordinary Language and Formal Language

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The relation between ordinary language (OL) and formal language (FL) affects greatly how to understand the revisability of the logic truths. Given Quinean refusal to the analytic statement, the revisability of the logic truths is nevertheless prudently treated by Quine, as he indicates, "if revisions are seldom proposed that cut so deep as to touch logic, there is a clear enough reason for that: the maxim of minimum mutilation." To what extent the maxim works and why we need it?

However, I will be afoot with identifying so called "two faces" of the logical truths by virtue of a characterization of the relation between OL and FL. Concerning the first face, logical truths appear constantly only if formal language, in which the logical truths is unfolded, and ordinary language, in which the logical truths is exemplified, are taken to be as a whole. That is, for example, Disjunctive Syllogism(DS) is ever acting only if the evaluation of "$A\wedge(\neg A\vee B)\rightarrow B$" is deemed only the same as that of its every intuitively justified replacements in ordinary language. Briefly, Talking about "$A\wedge(\neg A\vee B)\rightarrow B$" is solely equivalent to the talking of the right replacements, and they are the same talkings. Concerning the second, logical truths appear revisionally only if formal language has ordinary language as its frame of reference inasmuch as we separate them into two. For example, relevant logic attempts at formally characterize the ordinary meaning of "if…then…", and this characterization can be considered as making reference to the conception of what the real inference is in ordinary language. And when they do this, in effect they create one sort of formal language making reference to ordinary language in the sense that the former intends to describe the latter.

Which arguments are logically incorrect?

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What does it mean to say that an argument is logically incorrect? We can distinguish two natural interpretations of such a claim: we can construe it as i) saying that the argument is not logically correct (valid); or as ii) saying that the argument is incorrect, and is such for logical reasons. And though the former interpretation (which does not exclude that an argument can be both correct and logically incorrect) is more commonly adopted, we suggest that the latter one is preferable and more interesting. To articulate it precisely, though, is a more challenging task than it would prima facie seem. In this paper we try to fulfil this task. We start from reflections on the concepts of correctness and logical correctness. Subsequently we consider different approaches to defining the concept of logical incorrectness and propose an explication that is neither too narrow (as is for example Cheyne's concept of super-invalid argument) nor too broad (as is the concept of counter-valid argument) and satisfies the main desiderata - every logically incorrect argument is incorrect and its incorrectness is a matter of its logical form alone. We also show that if we want to stick to the tradition which identifies correctness of an argument with truth-preservation and identifies, as is standard, any compound consisting of set of sentences (premises) and a sentence (conclusion) as an argument, then logically incorrect arguments cannot be distinguished solely by their forms.

'Complete Sets of Logical Functions' Revisited: an examination and re-interpretation of early Functional Completeness proofs of Propositional Logic.

Serembus John
Humanities, Widener University, Chester, PA, USA

This paper examines various proofs for the functional completeness of sets of connectives/functions of Propositional Logic (PL) that were offered in the first half of the twentieth Century. Special attention will be paid to the article by William Wernick, "Complete sets of logical functions." Transactions of the American Mathematical Society 51, no. 1 (1942): 117-132. The present author will show why and how these proofs work (along with highlighting their significance) by employing his novel representation of the truth functions of PL using hexadecimal notation and 16x16 matrices.

The Epistemic Significance of Valid Inference – A Model-Theoretic Approach

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According to the paradox of inference (Cohen & Nagel 1998: 173) it is impossible for an inference to be both valid and its conclusion to possess epistemic novelty with respect to the premises. I argue in this paper that valid inference has an epistemic significance, i.e., it can be used by an agent to enlarge its knowledge, and this significance can be accounted in model-theoretic terms. I will support this thesis by offering grounds for each of its conjuncts.

I will argue first that this paradox is based on an equivocation. The main contention of the paradox is that in a valid inference the conclusion must be contained in the premises, and if it is contained then it cannot possess epistemic novelty with respect to the premises. The paradox arises because logical containment, i.e., logical implication, is identified with epistemological containment, i.e., the knowledge of the premises entails the knowledge of the conclusion. If these two meanings of the 'containment' are not distinguished then it will follow that a person who knows a set of premises will also know all its consequences, which is not the case, i.e., logical omniscience is impossible for a real epistemic subject.

Second, I will argue that a truth-conditional theory of meaning has the necessary resources to explain the epistemic significance of valid inferences. I will explain this epistemic significance by using

Carnap's semantic theory of meaning and Tarski's notion of satisfaction. In this way I will resist to (Prawitz 2012) claim that a truth- conditional theory of meaning is not able to account the legitimacy of valid inferences, i.e., their epistemic significance. A main aim of the explanation is to make explicit he relation between 'truth-conditions' and 'grounds' as central concepts in a theory of meaning.

A2.19 PHILOSOPHICAL LOGIC

Friday, August 7 • 14:30 –16:30
Main Building, Room 6

Applied ontology, logical pluralism, and the logical constants

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This talk discusses the interplay between applied ontology and philosophical logic in the study of logical constants and logical pluralism.

Generally speaking, applied ontology (AO) aims to make clear the assumptions on which a modelling approach or the interpretation of a collection of data rely. AO is strongly intertwined with logic since it relies on logic to improve conceptual clarity, robustness of the analysis as well as consistency of the result.

On the one hand, AO focuses on frameworks to represent, ontologically analyse, and logically reason about (possibly complex) systems from a given perspective (task or application domain). On the other hand, AO focuses on frameworks that an agent uses to understand what is to be represented. This latter perspective, called foundational, aims to be general and independent from tasks and domains.

We show how the new AO perspective and its methodologies can be applied to logic itself. In particular, we will focus on the analysis, from the AO viewpoint, of the meaning of the logical constants and of logical operators in different logical systems.

The role and meaning of logical constants has in recent years been discussed from many philosophical angles. We here propose to pursue a different line of analysis, where logical constants are selected and motivated in the light of their contribution to ontological needs as developed in AO. Of particular interest in this context is the role of logical pluralism, another topic heavily debated in philosophical logic in general. From the viewpoint of foundational AO, ontological pluralism is a pragmatic necessity. However, the ontological analysis of logical languages and the reflection of their role in ontological modelling leads to a new (homogeneous) framework for the co-existence of logics (pluralism) and for a better understanding of and a motivation for the distinction between logical and non-logical constants.

Sharpening Logical Independence

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A set of elements of a Boolean algebra (BA) is called independent if it is not equal to any of its proper subsets (Tarski, 1956, p. 82). This basic notion of logical independence, typically used in the theory of deductive systems, is very weak. However, as Tarski remarks, there are two different directions by which this idea has been sharpened (ibid, p.36 n.).

On one side a finite set of elements S belonging to a BA A is called "maximally independent" iff the principal filters generated by the elements of S do not have any element of A in common except 1. On the other side a finite set B of elements of a BA A is said to be "completely independent" iff B generates a free BA. The differences between the two notions and their philosophical relevance will be discussed.

Complete independence can be further refined by the notion of (logical) separability. Given a Boolean algebra A, a set B of elements of A\{0, 1} is said to be separable in A iff there exist a family of subalgebras {Ai} (i ∈ I) of A such that A is the internal sum (or free product) of Ai and every Ai contains exactly one element of B. While separability is stronger than complete independence with respect to finite BAs, in infinite atomless BAs it comes down to complete independence (D. H. Fremlin, 2003 – unpublished results). A refinement of separability, stronger than complete independence in a general way, is here proposed.

References Tarski, A. (1956). Logic, Semantics, Metamathematics, Oxford: Clarendon Press.

Designated Operator Theory and Domain of Symbol Expressions

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In the paper some extension of a designated J_1-operator theory (DOT) by J. Rosser and A. Turquette is proposed.

Let we have the class of many-valued logics L_i with designated truth-value 1 which is the co-domain of J_1-operator. The set of L_i-formulae is denoted as L_i-For and the union of L_i-For is L-For. P, P_1, denote meta-variables for L-formulae. If P is L-formula, then $J_1(P)$ is D-formula.

Iterations of J_1-operator are allowed. If D_1, D_2 are D-formulae, then $J_1(D_1)$, $\sim D_1$ and ($D_1 \longrightarrow D_2$) are D-formulae. D, D_1, denote meta-variables for D-formulae. Set of D-formulae is D-For and the system CL_2(D-For, $\sim, \longrightarrow$) will be introduced.

If A is L-formula or A is D-formula, then A is formula. A, A1, denote meta-variables for formulae. Set of formulae is For.

Definition 1. $(A_1 \supset A_2) \equiv_{df} (J_1(A_1) \longrightarrow J_1(A_2))$, $\neg A \equiv_{df} \sim J_1(A)$.

Axioms $(A \supset J_1(A)), (J_1(A) \supset A)$ and rule of inference: $A_1, (A_1 \supset A_2)/A_2$ are added.

Theorem 1. If $\vdash_{CL(For,\neg,\supset)} A$, then $\vdash_{DOT} A$.

Definitional domain for J_1-operator is extended to the set of symbol expressions of the language (words or strings of characters).

Now we extend the alphabet of DOT with: $s, s_1, s_2, \ldots$ - variables for symbol expressions; $\forall$ - universal quantifier; $\circ$ - concatenation operation. Let $\Sigma = \{s, s_1, \}$. If v is a variable for symbol expression, then v is the symbol formula. If S_1, S_2 are symbol formula, then $S_1 \circ S_2$ is symbol formula. If S is symbol formula, then $J_1(S)$ is D-formula. If v is a variable for symbol expression and D is D-formula, then $(\forall v D)$ is D-formula. Axioms for quantifier are also added.
The set of symbol formulae we denote as S-For and introduce For = (L-For $\cup$ S-For $\cup$ D-For).
Axioms and inference rules of the DOT are the same.
As a final result we obtain the system DOT(Σ).

Hypo: A Deduction-Theoretical Semantics for Heyting's Propositional Logic (HPL)

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Hypo is a *deduction-theoretic semantics* for Heyting's Propositional Logic (HPL). *Hypothesis* and *deduction under hypothesis* are primary concepts *vis-à-vis* the concept of *closed proof*.

BHK interpretation of implication states that the assertion of $A \to B$ requires a construction transforming any construction of A into a construction of B. We claim, this is not a sufficient condition for obtaining $A \to B$.

A *repertoire of hypotheses* $\mathcal{H}$ will be a finite subset of a language $\mathcal{L}$ ($\mathcal{H} \subseteq \mathcal{L}$). Two repertoires can be related by finite extension $\mathcal{H}' \succcurlyeq \mathcal{H}$, i.e., $\mathcal{H} \subseteq \mathcal{H}'$. The empty set is a limit case. For $\mathcal{L}_{\mathcal{B}}$ *the set of all basic sentences of* a sentential language $\mathcal{L}_s$ ($\mathcal{L}_{\mathcal{B}} \subseteq \mathcal{L}_s$), a *basis* is an ordered pair $\mathcal{B} = \langle \mathcal{B}_{\mathbb{P}}, \mathcal{B}_{\mathbb{R}} \rangle$ such that $\mathcal{B}_{\mathbb{P}}$ ($\mathcal{B}_{\mathbb{P}} \subseteq \mathcal{L}_{\mathcal{B}}$) is the specie of proved basic sentences and $\mathcal{B}_{\mathbb{R}}$ ($\mathcal{B}_{\mathbb{R}} \subseteq \mathcal{L}_{\mathcal{B}}$) the specie of refuted basic sentences.

Definition: *Hypo* semantics – Given a basis $\mathcal{B}$, valid assertion of A under a repertoire $\mathcal{H}$ ($\Vdash^{\mathcal{B}}_{\mathcal{H}} A$) in a basis $\mathcal{B}$ [**A is forced in repertoire $\mathcal{H}$ in a basis $\mathcal{B}$**] is defined as:

(basic1) $\quad A \in \mathcal{B}_{\mathbb{P}} \Leftrightarrow\ \Vdash^{\mathcal{B}}_{\varnothing} A$, for basic A;

(basic2) $\quad A \in \mathcal{B}_{\mathbb{R}} \Leftrightarrow\ \Vdash^{\mathcal{B}}_{\varnothing} \neg A$, for basic A;

(identity) $\quad \Vdash^{\mathcal{B}}_{\{A\}} A$;

(monotonic atomic) $\quad \Vdash^{\mathcal{B}}_{\mathcal{H}} A \Rightarrow\ \Vdash^{\mathcal{B}}_{\mathcal{H} \cup \mathcal{H}'} A$, for A basic or absurd;

(absurd) $\quad \Vdash^{\mathcal{B}}_{\mathcal{H}} \bot \Leftrightarrow$ for all $\alpha \in \mathcal{L}$: $\Vdash^{\mathcal{B}}_{\mathcal{H}} \alpha$;

($\wedge$) $\quad \Vdash^{\mathcal{B}}_{\mathcal{H}} A \wedge B \Leftrightarrow\ \Vdash^{\mathcal{B}}_{\mathcal{H}} A$ and $\Vdash^{\mathcal{B}}_{\mathcal{H}} B$;

($\vee$) $\quad \Vdash^{\mathcal{B}}_{\mathcal{H}} A \vee B \Leftrightarrow$ for all $\mathcal{H}^* \succcurlyeq \mathcal{H}$, for all $\alpha \in \mathcal{L}$:
$((\Vdash^{\mathcal{B}}_{\mathcal{H}^*} A \Rightarrow\ \Vdash^{\mathcal{B}}_{\mathcal{H}^*} \alpha)$ and $(\Vdash^{\mathcal{B}}_{\mathcal{H}^*} B \Rightarrow\ \Vdash^{\mathcal{B}}_{\mathcal{H}^*} \alpha)) \Rightarrow\ \Vdash^{\mathcal{B}}_{\mathcal{H}^*} \alpha$

($\to$) $\quad \Vdash^{\mathcal{B}}_{\mathcal{H}} A \to B \Leftrightarrow$ for all $\mathcal{H}^* \succcurlyeq \mathcal{H}$: $\Vdash^{\mathcal{B}}_{\mathcal{H}^*} A \Rightarrow\ \Vdash^{\mathcal{B}}_{\mathcal{H}^*} B$;

The implication clause states a **sufficient** condition for the assertion of an implication: semantic admissibility under all monotone finite extensions of an actual finite repertoire of hypotheses.

Theorem: $\nVdash^{\varnothing}_{\varnothing} \bot$.

Soundness is immediate.

A sentential language $\mathcal{L}_s$ is extended to a formula language $\mathcal{L}_f$ by adding denumerable propositional variables. **Completeness** is obtained by induction on the complexity of validated formulas of $\mathcal{L}_f$, observing that HPL for $\mathcal{L}_f$ is a conservative extension of HPL for $\mathcal{L}_s$.

A2.20 PHILOSOPHICAL LOGIC

Friday, August 7 • 14:30 –16:30
Main Building, Room 7

Product Update for Dynamified Deontic Logic of Speech Acts

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Inspired by the development of PAL (Public Announcement Logics), dynamic logics that deal with the effects of speech acts of commanding, promising, requesting, asserting, conceding, and so on are developed in the style similar to PAL. For example, a dynamic logic that deals with effects of acts of commanding and promising is developed by adding modal operators that stand for the types of acts of these kinds to a multi-agent variant of deontic logic. These new modalities are interpreted by model updating operations that cut deontic accessibility links between worlds. When this logic is combined with a multi-agent static epistemic logic, these operations, called ``deontic updates", yield a slightly surprising result: namely, the epistemic states of agents are updated in such a way that every agent comes to know what illocutionary acts has been performed. This happens because the language of this logic cannot represent the uncertainties agents may have about what has happened. Since one and the same sentence of natural language can be used to perform two or more kinds of illocutionary acts, however, the illocutionary force of an utterance can remain underspecified even if the addressee recognizes the sentence uttered, and knows the context of the utterance and the status of the utterer very well. The purpose of this paper is to examine how the ``product update" introduced in DEL (dynamic epistemic logic) can be adapted to represent such uncertainties agents have about what has happened in a dynamified deontic logic. It will turn out that the task is not trivial. Since the performing of an illocutionary act is standardly supposed to involve what Austin calls ``the securing of the uptake", if the addressee remains uncertain about what has been performed, it means that the uptake is not secured, and thus the attempted illocutionary act fails.

Justice-Based Responsibility

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In this paper, a concept of justice-based responsibility is discussed. We explicate the notion of an act used in law and ethics, in terms inspired by Wolniewicz's ontology of situations. We perceive any act as a choice between some alternative events. We define the internal value of an act as the difference between the value of the chosen alternative event and the value of the best of the remaining alternative events. Respectively, we define the external value of an act as the difference between the value of the chosen alternative event and its consequences, and the value of the best of the remaining alternative events and their consequences. This way, the evaluation of acts is reduced to comparing values of situations. Afterwards, we define: (i) a bad act as any act with negative internal value in an elementary choice situation (i.e. in a choice situation with exactly two alternative events, which both are atoms in Wolniewicz's sense), (ii) an internally wrong act as any act with negative internal value, and finally (iii) an externally wrong act as any act with negative external value. Among these three notions, the notion of an externally wrong act seems to be the most suitable criterion for the attribution of a justice-based responsibility. This is because if one admits as the criterion in question the internal value of an act, one consequently arbitrarily excludes from assessment all consequences of alternative events. However, if we choose the notion of an externally wrong act as the criterion for evaluation of the acts, we must admit that the attribution of a justice-based responsibility depends on the consequences of alternative situations. This fact sets down the limits for the objective attribution of a justice-based responsibility.

Temporal Enclosure Structures

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Formal models of time are extensively applied in various disciplines, ranging from metaphysics and the foundations of science to tense logic and artificial intelligence. For the most part, however, such models are based on some primitive binary relation of temporal precedence, which is generally assumed to be a partial order. This choice has two major disadvantages: firstly, it rules out closed or partially closed temporal structures by fiat; and secondly, it makes the resulting models hardly generalizable to the spatial case, where no analogous relation of precedence can be found. This paper presents an alternative approach to temporal modelling, which aims to overcome such limitations while retaining the advantages of the standard approach. The assumed primitive is the reflexive, and transitive relation of temporal enclosure, which is meant to hold between two events just in case the former one takes place while the second one occurs. On this basis, the derivate relations of overlap, connection and external connection are defined. This makes the proposed model akin to the region connection calculus approach to spatial reasoning in artificial intelligence, whose fundamental notions it replicates, though with a different interpretation. This ensures that a generalization of the model to the spatial case be possible, thus overcoming the latter of the two problems generally affecting temporal models. Furthermore, three fundamental axioms are assumed: one in order to allow the model to distinguish between differing temporal topologies, one in order to allow for the composition of neighboring events, and one in order to ensure the internal connectedness of each event. The resulting model is then demonstrated to be compatible with closed temporal structures, as well as with linear and branching ones.

Future contingents, partial models and the flow of time

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Contemporary solutions to the problem of future contingents involve rejecting at least one of the following very intuitive principles : sempiternality of truth (i.e., sentences do not become true or false through time), necessity of the present (i.e., whatever is true now is irrevocably true), or the law of excluded middle. This work proposes a new solution to the problem which preserves all three intuitions, while rejecting an often overlooked fourth logical principle, namely that a disjunction is true only if one of the two disjunct is.

I will first provide a simple reconstruction of the fatalist argument, proving that no model of temporal logic satisfying the four principles above can allow for future contingent statements, and then motivate a solution based on the rejection of the fourth principle. Understanding the contingency of the future as closely related to partiality and indeterminacy rather than genuine modalities, I will propose a new model of temporal logic, based on linear rather than branching semantics for time, and I will make use of partial logic and supervaluations in order to represent both the settledness of the past and the openness or indeterminacy of the future.

Finally, I will shed light on some conceptual issues raised by this solution regarding the relationship between models of temporal logic and the actual flow of time : I will argue that, if time is really indeterministic, then branching models of time are mistaken in claiming that they can eternally represent time, i.e. give a static representation of the actual world that does not vary over time. By contrast, the dynamic view that I will present is not committed to a complete, eternal description of the actual world, but rather to a partial description that gets completed as time itself passes.

A2.21 PHILOSOPHICAL LOGIC

Friday, August 7 • 17:00–19:00
Main Building, Room 6

The Quantified Argument Calculus and Natural Language

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I present the Quantified Argument Calculus (Quarc) and show how it sheds light on various aspects of NL. Quarc is a recently developed logic system in which quantifiers join one-place predicates to form arguments, as in NL syntax. In NL, both 'John' and 'All students' occur in the argument place of the sentences, 'John is clever' and 'All students are clever'. Correspondingly (writing the argument to the left of the predicate), these two sentences are formalised in Quarc as (j)P and (∀ S)P.

The formal system is introduced, and distinction between it and the Predicate Calculus are noted. For instance, like NL, Quarc has both sentential negation and predication negation. NL sentences 'It's not the case that John is clever' and 'John isn't clever' are formalised, ¬(jP) and (j)¬P. This is essential when quantified sentences are considered, for predication negation is necessary for capturing the difference between 'It's not that some students are clever' and 'Some students aren't clever': ¬(∃ SP) and ∃ S¬P. This explains the semantic reason why all natural languages contain both modes of negation, a thing redundant and absent from the PC. We see that Quarc, being closer to the syntax of NL, can explain this feature of NL.

I continue to introduce a few more features of Quarc. For instance, while Quarc makes no use of variables (again sharing this feature with NL, unlike the PC), it has to make use of anaphora. Similarly, expressive completeness forces Quarc, like NL and unlike PC, to have some of way of reordering the arguments in the sentence, in this manner explaining the presence of some such device in any language.

Some additional results are also presented, e.g. the extension to modality, where again we have closer proximity to NL. The formal properties of Quarc are also mentioned: soundness, completeness, etc.

CONTRIBUTED PAPERS / A2.21 PHILOSOPHICAL LOGIC

Games and the pragmatics of quantifier scope disambiguation

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One standard assumption in logic and in the semantics of natural languages is that a sentence whose surface syntax displays two or more different quantifier phrases is ambiguous. Scope ambiguities arise when the distributions of quantifiers at the level of the sentence's logical form generate different interpretations of the sentence. When the first quantifier syntactically profiled in the sentence outscopes the second quantifier, the former has a wide scope while the latter, being in the nuclear scope of the former, has a narrow scope. The inverse scoping is when the above mentioned linear order of the quantifiers is reversed: the second quantifier scopes over the first and consequently takes a wide scope. In this paper, I will isolate, according to my own methodological principles, a class of doubly-quantified sentences having a reading which is pragmatically blocked. Sentences in which the occurrence of the determiner corresponding to the existential quantifier syntactically precedes the occurrence of the determiner corresponding to the universal quantifier, will have an object narrow scope reading which is pragmatically blocked and formally not entailed by the object's wide scope reading. Similarly, sentences in which the occurrence of the determiner corresponding to the universal quantifier is syntactically introduced before the occurrence of the determiner corresponding to the existential quantifier, will have an object narrow scope reading which is pragmatically prefered to a wide scope interpretation of the object which, in this case, will be contextually blocked. In order to explain the quantifier scope disambiguation and the contextually dispreferred reading of these doubly-quantified sentences, I will use a game-theoretical analysis. I will offer arguments showing that the preferred reading is a Pareto-efficient Nash equilibrium of the game which models these sentences' interpretation and that this unique solution is best captured within the Parikh's framework of games of partial information.

An explication of the concept EXPLICATION in the framework of hyperintensional logic

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Carnap's work on explication (1947, 1950) has been recently intensively studied (see e.g. Klein and Awodey 2004, Carus 2007, Wagner 2012). That the very concept EXPLICATION is not generally well understood is evident from the common view (e.g. Belnap 1993) that explication is something like a definition. A little reflection reveals that such view is certainly wrong: Carnap's explication replaces an intuitive, imprecise concept (the explicandum) by a rigorous correlative concept (the explicatum). In his "An Explication of 'Explication'" (1968) Hanna identified explication with the function which maps predicates such as P to predicates such as Q, whereas the extensions of P and Q are similar. There are several reasons why Hanna's otherwise valuable attempt should be dismissed. For example, his proposal makes explication language dependent: his explication of the ('international', language independent) concept EFFECTIVELY CALCULABLE FUNCTION turns to be an explication of the English expression "effectively calculable function" only. I suggest a rivalling explication whose pivotal idea is that we explicate concepts, not object; only concepts, not objects, can encompass contradictory properties, which corresponds to conflicting intuitions as regards a particular notion. The logical framework here employed is rather general; it is Tichý's (1988) ramified version of simple type theory. The framework enables us to implement (not only) Church's (1950, 1984) idea that any expression expresses a concept - a structured, hyperintensional procedure - which determines an object, which is the denotatum of that expression. (For such explication of the concept CONCEPT see e.g. Materna 2004, or Duží, Jespersen, Materna 2010 and my 2011, 2014.)

I explain that the concept EXPLICATION (which belongs to meta-explication framework) determines a partial identity function from concepts to concepts (this can be widened to classes of concepts). I demonstrate that the proposal fits Carnap's four conditions characterizing explication and other desiderata.

A2.22 PHILOSOPHICAL LOGIC

Saturday, August 8 • 10:00–12:00
Main Building, Room 6

Constructive Validity and Admissibility

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Prawitz's and Dummett's proof-theoretic accounts of validity may be viewed as elaborations of the informal BHK semantics along the way indicated by Gentzen. According these accounts, the usual inference rules may be regared as scheme for open arguments. An open argument is valid if there is an effective procedure which yields a valid closed argument for the conclusion when applied to valid closed arguments for the premises, valid closed argument being explained in terms of the meaning-constitutive canonical arguments for a proposition. And such an effective procedure amounts to the canonical proof of the corresponding conditional. These accounts suggest a close analogy with the admissibility of inference rules. Although the usual notion of admissibility is relative to formal systems, we may develop an absolute notion of admissible inference rules based on absolute notions of proofs and propositions which are needed for elaborations of BHK semantics anyway. Once this absolute notion of admissibility is properly understood, it provides a new perspective to the proof-theoretic accounts of validity. Given the meaning-constitutive self-justified introduction rules, it may be argued that the usual elimination rules are justified because these rules are admissible, though not derivable. There are well-known inference rules which are, though not derivable, admissible in the intuitionistic logic. It does not immediately follow that the usual system for intuitionistic logic is incomplete with respect to the prooftheoretic semantics under consideration or even with respect to the BHK semantics. But it raises some interesting questions regarding the relationship between those semantics and the usual inference rules, in articular, the rules regarding the conditional. I shall clarify these questions and pursue them.

Untyped validity: from interaction to rules

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Proof-theoretic validity is usually defined as a property of derivations built according to a previously defined set of rules (see Prawitz[1971]). Yet, "validity should be a distinguishing feature, telling that some derivations are valid while some others are not" (Schroeder-Heister[2006]). As a consequence, a wider setting should be investigated, allowing for invalid derivations. To this end, we introduce Pure Natural Deduction, in which derivations are defined as abstract trees. Pure (or "untyped") derivations can be regarded as possibly invalid: they reproduce the computational behavior of pure lambda-terms, including the possible violation of the normalization property. On the other hand, intuitionistic natural deduction (NJ) derivations can be seen as "typed", i.e. as trees whose nodes and branches are labeled, respectively, by formulae and rules. For every formula A, we define validity with respect to A as a property of pure derivations (in the style of Tait-Girard reducibility technique for typed lambda-calculi - see Tait[1967], Girard[1972]). Finally, we show that NJ is complete in the following sense: for every formula A, if d is a closed normal pure derivation which is valid with respect to A, then a closed normal NJ derivation of A can be recovered from d. Since introduction/elimination rules for standard connectives do not appear in pure derivations, validity cannot be stated by reference to logical rules. Indeed, in the untyped setting, valid derivations are characterized solely by the behavioral properties manifested by their mutual interaction. Nevertheless, as a corollary of our completeness theorem, we are able to recover the usual properties of validity à la Prawitz. In particular, a closed normal derivation which is valid with respect to a formula A corresponds, in the typed setting of NJ, to a derivation ending with the rule introducing the principal connective of A.

On Dummett's Verificationist Justification Procedure

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Sanz Wagner
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Prawitz and Dummett, among others, proposed proof-theoretic inductive definitions of validity for arguments. These definitions incorporate ideas from proof theory (as expressed in the work of Gentzen) and intuitionistic philosophy of logic and mathematics (as expressed in Heyting's BHK interpretation). They assume that introduction rules provide the canonical assertability conditions for complex sentences based on assertability conditions of their constituents. In this paper, we investigate the prooftheoretic verificationist justification procedure proposed by Dummett in his book "The Logical Basis of Metaphysics". We advance two possible interpretations of Dummett's procedure (dependent and independent) and we evaluate adequacy of intuitionistic propositional logic with respect to them. These interpretations try to make precise the exact role played by boundary rules in Dummett's justification

procedure. First, in a fragment of propositional logic, we prove the validity of a classical rule (Peirce's rule) under the independent interpretation. Next, we discuss how the dependent interpretation avoids validation of Peirce's rule and features some surprising properties. Finally, we provide a natural and constructively plausible extension of the natural deduction system for propositional intuitionistic logic in which we can show the validity of another intuitionistically underivable rule under the dependent interpretation.

Completeness results in proof-theoretic semantics and the treatment of negation

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Within proof-theoretic semantics the validity of atomic formulas is usually defined in terms of their derivability in atomic systems, and the validity of complex formulas is explained with respect to atomic systems. For example, an implication $A \rightarrow B$ is valid with respect to an atomic system iff for all extensions of that system it holds that whenever A is valid with respect to an extension then also B is valid with respect to it. Atomic systems can be sets of atomic formulas, production rules, atomic rules which can discharge atomic assumptions, or higher-level atomic rules which can discharge assumed atomic rules. Extensions of atomic systems can also be restricted to consistent atomic systems. Depending on the kind of atomic systems considered, there are positive as well as negative completeness results for minimal and intuitionistic logic.

Proof-theoretic notions of validity do not only differ by the kinds of atomic systems underlying them. They also differ in how negation or absurdity $\perp$ is explained. One option is to treat $\perp$ as a logical constant by saying that there is no atomic system in which $\perp$ is valid. Other options are to define $\perp$ to be valid in an atomic system iff all atomic formulas are valid in that system, or to treat $\perp$ as a distinguished atom. In the latter case, a notion of validity for minimal logic can be generalised for intuitionistic logic by extending atomic systems by the set of atomic rules $\{\perp/A : A \text{ atomic}\}$. Furthermore, atomic systems could be considered as inductive definitions of atomic formulas. In this case, a principle of ex falso quodlibet becomes justified for each atomic formula not defined by a given definition.

In this talk we present completeness results for several notions of proof-theoretic validity, and we discuss their dependence on different treatments of negation.

A2.23 PHILOSOPHICAL LOGIC

Saturday, August 8 • 13:30–15:30
Main Building, Room 7

On Virtuous Inferring

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It is often argued that theoretical rationality and theoretical reasoning have features of practical rationality and practical reasoning. It is no news that theoretical inferrings and inferences can be described by means of normative vocabulary that applies to actions. However, what a few philosophers have proposed goes further. For example, Robert B. Brandom (Articulating Reasons, 2000) has construed Gottlob Frege's Begriffsschrift as an early representative of expressivism in logic and inferentialism, and has thus shifted the focus from the Fregean ideal realm of thoughts to the inferrer and her inferrings. Recent articles by Dag Prawitz (2013) and Olav Gjelsvik (2014) point to the same direction. They start with the observation that for Frege, logic is the study of inferences construed as acts. Gjelsvik argues that this emphasis makes it possible to consider Fregean inferences in terms of virtue epistemology. Instead of studying abstract objects like thoughts and their inferential relations, the present paper continues the line of thought proposed by the mentioned philosophers and focuses on the inferring agent and her entitlements, commitments, and virtues. The problem is posed whether the shift of focus from ideal entities to human action brings in naturalism that would not fit in with a Fregean approach. It is shown that the turn to the inferring agent's virtues is compatible with the antinaturalistic view on the foundations of logic. The paper argues that if inference is understood as a series of acts and the inferrer is evaluated in moral terms, the Fregean idea that the laws of logic constitute rationality and the reflective question concerning the justification of the very laws of logic must be construed in a new manner. They turn into the question whether the agent is free to choose between alternative logics or merely between alternative acts in a logic.

Transconsistency: Consistent Identity of Proofs in Inconsistent Logic

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Transconsistent logic is a propositionally inconsistent, nevertheless inferentially consistent logic; put another way, it is logic with inconsistent identity of propositions, and yet with consistent identity of proofs. It therefore does not admit any semantics of provability, but may allow for coherent semantics of proofs. Is there any such transconsistent logic at all? There is indeed: Prior's weird connective "tonk" yields a transconsistent system of logic. In this talk, I aim at elucidating conceptions of inconsistency by means of a novel analysis of Prior's tonk. As is well known, Prior's tonk posed a sort of demarcation problem in logic: what rules are meaning-conferring and define a proper logical constant, and what do not? Prior's pathological connective "tonk" is generally supposed to ought to be excluded from proper logical constants, and yet there are still on-going debates on what exactly is wrong with Prior's tonk.

In this talk, I argue from the perspective of categorical inferentialism that (i) two notions of inconsistency should be distinguished in an appropriate account of tonk; (ii) logic with tonk is inconsistent as a theory of propositions, and this inconsistency is actually caused by equivocation; (iii) yet, in contrast to this diagnosis of the Prior's tonk problem, nothing is actually wrong with tonk if logic is viewed as the theory of proofs rather than propositions, and Prior's tonk perfectly makes sense in terms of identity of proofs. Indeed, there is fully complete semantics of proofs for tonk, which allows us to link the Prior's old idea with contemporary developments at the interface of logic, computer science, and physics, at the same time yielding a transconsistent system of logic.

Dualism about Unrestricted Generality

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I propose a new, dualist approach to unrestricted generality. Its basis is Frege's distinction between objects and concepts (Frege 1892) and two Priorean claims: (P1) objects exist relative to contexts, and (P2) this contextualist ontology must ultimately be described *from the inside*, in a tense logical language (Prior 1967 & 2003). Thus quantified statements turn out to be systematically ambiguous. E.g., 'Every F is G' according to the (modern) *objectual* reading means that every current Fer is among the current Gers; according to the (traditional) *conceptual* reading, it means that the concept Fing includes the concept Ging, and refers to no particular object (e.g., Frege 1914, 213; *Grundlagen* §47). Because of (P1) and (P2), we need a logic that formalizes *both* readings: Let us add a pair of *conceptual quantifiers* ('Π', 'Σ') to the usual *objectual quantifiers* ('$\forall$', '$\exists$') of a metric tense logic with operators 'P_n' and 'F_n'. Let both pairs of quantifiers be governed by the usual rules and add the interaction law '$\Pi\xi\ \varphi(\xi) \rightarrow \forall x\ \varphi(x)$'. The ensuing (first-order) *logic of double quantification* can easily be shown to have the desirable meta-logical properties, by interpreting it in its single quantification counterpart. Ultimately, though, only the semantics of *objectually* quantified statements is model-theoretic (cf., e.g., Fitting / Mendelsohn 1998); and the semantics of *conceptually* quantified statements is inferentialist (e.g., governed by Carnapian meaning postulates).

Regarding the problems of unrestricted generality, we now can eat our cake and have it, too: Some absolutist intuitions (Williamson 2003; cf. Fine 2006, 41) are accommodated by conceptual quantification. E.g., 'everything is self-identical' gets '$\Pi\xi\ \xi = \xi$'. And the relativist position can be stated in a non-self-refuting way by objectual quantification, because of the metric operators. E.g., 'the domain is indefinitely extensible' gets '$\Box\exists n F_n \exists y P_n \forall x\ x \neq y$' (cf. Cresswell 2013), instead of Fine's awkward object-language quantification over interpretations, '$\Box\forall I \Diamond\exists J\ I \subset J$' (Fine 2006, 30). Thus, the dualist approach is relativist about *objectual generality* and absolutist about *conceptual generality*. It radicalizes the modal element of Fine's relativism (Fine 2006, 29ff.) and generalizes the inferentialist element of Williamson's absolutism (Williamson 2006).

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A2.24 PHILOSOPHICAL LOGIC

Saturday, August 8 • 13:30–15:30
Main Building, Room 17

1 Fregean Function Levels in Formal Languages

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Modern predicate logic realizes in its formal languages Rasselian predicate orders but not Fregean function levels. Moreover, a predicate is just a partial case of a function, so predicate logic is not extremely wide and can be generalized to *function logic*. A function in this latter logic is no longer a map but a partial multimap, i. e., it can assign to any list of its arguments any number of values (including 0) and can have no arguments at all (i. e., can be a 0-ary function). If object s is a value of function t, we write down this fact by *representation formula*

$$s \approx t,$$

where representation $\approx$ is a generalization of equality. For instance, if individual a_0 is a value of function f at arguments $a_1, \ldots, a_n$, we write down this fact as

$$a_0 \approx f(a_1, \ldots, a_n).$$

If there are functions among values of function t, and s is a value of one of such functions, then s is a value of a value of t; we write down this fact as

$$s \approx (t);$$

hence, a value of a value of ... a value of t (n times) has been written as '$(\ldots(t)\ldots)$' ($n-1$ pairs of parentheses around of 't'). This is concerned with values of functions; we sign the very function f with arguments $a_1, \ldots, a_n$ (with argument places $x_1, \ldots, x_n$, with no argument) by

$$f^{a_1,\ldots,a_n}$$

(by

$$f^{x_1,\ldots,x_n}$$

and

$$f^{\lambda}$$

respectively). So we obtain tautology

$$s \approx t \to (t^{\lambda} \approx r \to s \approx (r)).$$

The above expressions belong to untyped function logic (an outline of first-order function logic see in [1]).

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A3

A3.1 COMPUTATIONAL LOGIC AND APPLICATIONS OF LOGIC

Thursday, August 6 • 11:00–13:00
Main Building, Room 15

Procedural specification of beta-conversion

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Though beta-conversion is the fundamental computational rule of lambda-calculi and functional programming languages, it is underspecified by the commonly accepted rule \x C(x)(A) |- C(A/x). The problem is this. Procedure of applying the function \x C(x) to the argument presented by A can be executed in two different, mutually non-equivalent ways, to wit (a) by value or (b) by name. If by name then procedure A is substituted for all the occurrences of x into C. In this case there are two problems. First, conversion of this kind is not guaranteed to be an equivalent transformation as soon as partial functions are involved. Second, it may yield loss of analytic information of which function has been applied to which argument. The idea of conversion by value is simple. Execute the procedure A first, and only if A does not fail to produce an argument value on which C is to operate, substitute this value for x. This way logical equivalence is preserved and there is no loss of analytic information. Moreover, in practice it is more efficient. The efficiency is guaranteed by the fact that procedure A is executed only once, whereas if this procedure is substituted for all the occurrences of the lambda-bound variable it can subsequently be executed more than once. The notion of reduction strategy in lambda-calculi is similar to the evaluation strategy in programming languages. Only purely functional languages such as Clean and Haskell use call-by-name. For instance, Java does not pass arguments by reference, but by value. My novel contribution amounts to a specification of an evaluation strategy by-value as adapted to Transparent Intensional Logic, TIL. My proposal of the substitution method operating on procedures is similar to Chang & Felleisen (2012)'s call-by-need reduction by value. But their work is couched in an untyped lambda-calculus. TIL, by contrast, is a hyperintensional, partial typed lambda-calculus.

A Behavioral Hierarchy of Strategy Logic

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Since the very beginning, logic-based approaches have been fruitfully employed in the specification and verification of computational artefacts. Nowadays, such artefacts typically interact with users that might strategically act in order to jeopardise them. Consequently, starting from the seminal work introducing the Alternating Temporal Logic (ATL*), strategic reasoning have assumed a prominent role in the field of formal specification and verification. With the aim of describing sophisticate interactions among agent behaviors, new and more powerful logics have been recently introduced. Among the others, Strategy Logic (SL) treats agents' strategies as first-order objects and allows to use existential and universal modalities over them.

Using such modalities, key game-theoretic properties such as Nash equilibria and sub-game perfect equilibria, which are not expressible in ATL*, can be easily described. However, the high expressiveness of SL incurs in an increased complexity of related decision problems. For instance, by abandoning ATL* in favour of SL, the model checking problem becomes, from 2ExpTime-complete, NonElementaryTime-complete. Clearly, this heavily limits the concrete applicability of SL and demands to look for some syntactic fragments which still gain something with respect to ATL* in terms of expressiveness, but remain at the same level of complexity. Giving a closer look at SL, one of the prominent sources of complexity derives from the fact that the satisfaction of a formula may require non-behavioral strategies where a choice of an agent, at a given moment of a play, depends on the choices other agents make in the future or in counter-factual plays. In this paper, we restrict our attention to a fragment of SL, called Alternating-Goal SL and show that behavioral strategies alone suffice to check whether a formula is satisfied. Specifically, we study the model-checking problem for this restriction, showing that it 2ExpTime-complete, just as for ATL*.

Logics for Collective Reasoning

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In this paper, we discuss the approach based on Social Choice Theory and Judgment Aggregation to the definition of collective reasoning. We shall make explicit the aggregative nature of the notion of collective reasoning that is defined in the Judgment Aggregation account and we shall stress that the notion of logical coherence plays a fundamental role in defining collective attitudes. Unfortunately, as several results in Judgment Aggregation show, coherence is not compatible with fair aggregation procedures. For instance, the majority rule does not guarantee consistent outcomes, as soon as we assume that individuals are capable of very simple logical reasoning. This fact has been generalised to an impossibility theorem by List and Pettit that proves that no aggregation function that satisfies a number of reasonable fairness properties can guarantee rational outcomes.

On closer inspection, the notion of coherence that is jeopardized by Judgment Aggregation is based on classical logic. In this work, we propose to revise the standard view of rationality of Judgment Aggregation by exploring the realm of non-classical logics. in particular, we will present possibility results for substructural logics. Those logics, we argue, provide a viable notion of collective reasoning.

In particular, we will endorse a proof-theoretical view of logic and we shall analyse which inference rules are responsible of inconsistencies at the collective level.

Modeling decision-making under ignorance and uncertainty

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The traditional approach to decision theory has a very limited application. According to the traditional model of decision-making in order to judge a decision (to perform an action) of a given agent as rational we need to have a set of all possible outcomes (Omega), an agent's utility function (u: Omega → R) and a probability measure, which specifies the probability of certain outcome occuring given that the agent performs a certain action. However in most of everyday decisions (certain gambling games being the exception) we have none of the above elements. Our aim is to model human reasoning in relatively broad range of problems involving decision making. In our talk we will present a framework for decision-making with limited information (decision- making under ignorance) and uncertainty about agent's goals and preferences. We will also allow for the revision of goals and preferences. In this framework we will define the notion of rationality and present decision criteria for making a rational decision relative to the agent's knowledge. We will then show that the traditional approach to decision-making is a special case of our more general, qualitative approach. In the second part of the talk we will set our framework in the context of propositional dynamic logic with epistemic and deontic operators and discuss certain possible axioms regarding qualitative decision making with reference to the abovementioned notions and criteria.

A3.2 COMPUTATIONAL LOGIC AND APPLICATIONS OF LOGIC

Thursday, August 6 • 14:30–16:30
Main Building, Room 10

Belief Revision for Non-Monotonic Knowledge Bases

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The formalisation of reasoning with uncertainty is of central importance in computational and philosophical logic. Two of the dominant approaches in this regard are the areas of non-monotonic reasoning and belief revision. The former is concerned with the formal modelling of information that is intrinsically defeasible, while the latter deals with the formal characterisation of changes to be made to a knowledge base in the presence of new, and possibly conflicting information, with attention being paid to preserving logical consistency and minimising the loss of information. Although there is a well-known formal connection between a specific branch of non-monotonic logics and belief revision, what is lacking is a comprehensive proposal for combining non- monotonic reasoning and belief revision in a single framework.

Our aim here is to fill that gap. We identify two forms of revision that can be applied to non-monotonic reasoning systems. The first type is similar to classical belief revision, and is aimed at the preservation of the logical consistency of the system in the face of new evidence, possibly eliminating previous information. With the second type of revision we investigate the possibility of replacing classical statements with their (weaker) defeasible counterparts in order to preserve the logical coherence of the system (with the definition of coherence being that a select set of formulas are guaranteed not to be necessarily false). Starting from the postulates characterising classical belief revision, we present an analysis of the desiderata and the constraints that our two kinds of revision should satisfy, and how they should interact.

An interesting application of this topic is in Philosophy of Science, where non-monotonic reasoning can be used to characterise the interaction between a scientific theory and empirical evidence, and belief revision can be used to formalise the notion of a rational modification to existing scientific theories.

On The De-Semantification and Re-Semantification of Deep & Expert Disagreements: Inquiries on Formalization Design and Adequacy Criteria

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This work aims at investigating the philosophical project that suggests that formal languages may be conceived as epistemic tools for debiasing spontaneous reasoning patterns, through the virtuous integration of both de- semantification (Krämer, 2003) and re-semantification (Dutilh Novaes, 2014) processes. My work focuses on examining the results of such a project applied to the problem of conceiving deep disagreements, and - in particular - expert disagreements.

In the recent history of informal logic, deep disagreements have been traditionally interpreted as describing a type of intractable "clash of underlying principles", amenable only to persuasion (Fogelin, 1985). Luggs (1986) critically revised Fogelin's conceptualization of deep disagreement, to be amenable to rational resolution, in a dynamic approach to rationality: "reason may not be sufficient to decide a particular issue here and now but it may still contribute significantly to its resolution later on". Further integrating the dynamic picture, Adams (2005) rejected the very possibility of specifying a priori the conditions to assert when a disagreement is deep. Such rejection indicated that the only way to know when a disagreement would be deep would be to entirely avoid the path of persuasion proposed by Fogelin, and instead, embrace debate, in the limit of exhausting normal discourse. Through debate, discovery may be the case, and both ground-level argumentation and meta-argumentation may be identified in particular disagreements in the quest for knowing their "depth".

The integrated de-semantification and re-semantification treatment of such unclear disagreements (in Adam's descriptive sense) may provide an alternative cognitive debiasing technology for epistemically improving our understanding of such conundrums, within a dynamic, non-monotonic reasoning perspective. In this analysis, the description of ground-level and meta-level argumentation of disagreements in their specific domains through formalization and adequate application criteria, may suggest a new classification for expert disagreement as well, through meta-argumentation mapping, for debate and discovery.

A3.3 COMPUTATIONAL LOGIC AND APPLICATIONS OF LOGIC

Thursday, August 6 • 17:00–19:00
Main Building, Room 17

Granular Mining of Logical Rules from Relational Structures

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Granular computing (GrC)is an emerging technology with problem-solving concepts deeply rooted in human thinking, and rough set theory is an effective GrC tool that has been successfully applied to knowledge discovery from data tables. In recent years, the application of rough set analysis has been extended to relational structures such as ontology graphs or social networks. Unlike classical rough set theory, in which the attribute values of objects fully determine the indiscernibility relation, the rough set analysis of relational structures must account for the relationships between objects. In the previous study, the indiscernibility relation with respect to relational structures is defined by using the notions of positional equivalences in social network analysis. The indiscernibility relation can partition a relational structure into elementary information granules (IG) which are used to define the lower and upper approximations of an arbitrary subset as in classical rough set theory. However, to induce rules from such approximations, we need a knowledge representation formalism. In this paper, we use description logics (DL) to represent knowledge discovered from relational structures and present a constructive procedure to find a characterizing DL concept for each IG. Because the lower and upper approximations of a target set are unions of IG's, we can induce rules with the disjunction of such characterizing concepts as their antecedents. This leads to a complete process of granular data mining from relational structures.

Finitely Unstable Theories and Computational Complexity

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Stability theory separates first order (FO) theories with infinite models into stable ones that have a "small" number of non-isomorphic models and unstable ones that have a large - in fact exponential - number of non- isomorphic models with respect to the infinite cardinality of the corresponding set of constants. In this presentation we pursue an analogue of this distinction in the case of FO theories over a finite, even bounded, set of parameters. Such a bound is induced by a bound M on the definition length of the corresponding binary encoding of the theory. As a vehicle for this analysis we use the propositional satisfiability problem SAT restricted to bounded definition length. In this restricted setting the bounded restriction of SAT is rendered definable in FO and it can be shown to be finitely unstable, in the sense that the bounded FO theory SAT_M only has models with cardinality that is exponential in M. The property of finite instability is further translated into a lower bound on the deterministic computational time complexity of the corresponding bounded decision problem by encoding in FO an arbitrary deterministic Turing machine (DTM) that decides SAT_M. It can be shown that there is an isomorphism between an FO-definable set of non-isomorphic propositional models of SAT_M and the FO-definable set of equivalence classes of DTM computations that decide all the corresponding instances of SAT_M. This isomorphism yields a lower bound on the size of any model of SAT_M as a FO theory, and also one on the size of any model of the corresponding FO-definable set of DTM computations. This lower bound on model size also carries over to a lower bound on the deterministic time complexity of SAT when the bound M is allowed to grow without limit.

Bi-Logic Via Infinite Singletons

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Bi-logic [1] describes two sides of the human thinking, the rational reasoning (asymmetric mode) and the symmetric mode, also termed indivisible mode, where any relation is symmetric and any set is infinite.

In a quantum model [2], we have characterized the class of finite sets for which the membership relation can be expressed as a finite propositional disjunction of equalities, in the object language. Finiteness can be recognized, at the object level, only when this happens. In particular, one can conceive an infinite singleton, dropping, in the object language, the closed term which denotes its unique element. Infinite singletons satisfy the symmetry property as well, since the class of sets where any relation is symmetric is exactly the class of singletons.

The logic of infinite singletons represents a symmetric kernel, in sequent calculus [3]. It has the features of the symmetric mode: absence of mutual contradiction and condensation, absence of negation, absence of time, and displacement. The direction of logical consequence becomes irrelevant. In this setting, one can develop the definition of a generalized quantifier, disappearing once consequence is recovered, that represents correlations. Considering the structural rules of

sequent calculus, this suggests a possible approach to the problem of the representation of contextual reasoning and other kinds of human reasoning in artificial intelligence [4].

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Level system of formulas for decreasing the number of proof steps of formulas simulating some Artificial Intelligence problems

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The solving of many Artificial Intelligence problems may be reduced to the proof of a series of formulas (for $k = 1, \dots, K$) in the form

$$S(a_1, \dots, a_t) \Rightarrow \exists (x_1, \dots, x_m)_{\neq} A_k(x_1, \dots, x_m), \qquad (1)$$

where $(a_1, \dots, a_t)$ are constants, $(x_1, \dots, x_m)$ are variables, $S(a_1, \dots, a_t)$ is a set of atomic formulas or their negations, $A_k(x_1, \dots, x_m)$ are elementary conjunctions. The notation $\exists (x_1, \dots, x_m)_{\neq} P$ is used for the formula $\exists x_1 \dots x_m (x_1 \neq x_2 \,\&\, x_1 \neq x_3 \,\&\, \dots \,\&\, x_i \neq x_j \,\&\, \dots \,\&\, x_{m-1} \neq x_m \,\&\, P)$. The verification problem of such a formula is NP-complete and the complexity of an algorithm based on the derivation in sequential calculus or on the use of resolution method is $O(s^a)$ where s and a are the numbers of atomic formulas in $S(a_1, \dots, a_t)$ and $A_k(x_1, \dots, x_m)$ respectively.

Below it is suggested an algorithm of extracting common (up to the names of variables) sub-formulas $P_i^1(y_1, \dots, y_\mu)$ of $A_1(x_1, \dots, x_m), \dots, A_K(x_1, \dots, x_m)$. These sub-formulas are changed in $A_k(x_1, \dots, x_m)$ by new predicates $p_i^1(y_i^1)$ with new variables y_i^1 for the lists of initial variables. The obtained formulas are denoted by $A_k^1(x_1, \dots, x_m, y_1^1, \dots, y_{n1}^1)$. The use of such common sub-formulas allows to construct a level system of formulas in the form (1) with the change of $A_k(x_1, \dots, x_m)$ by $A_k^1(x_1, \dots, x_m)$. The use of such a level system decreases the exponent in the complexity bound of the mentioned algorithms up to the $O(s^\alpha)$, where α is the maximal number of atomic formulas in $P_i^1(y_1, \dots, y_\mu)$ and $A_k^1(x_1, \dots, x_m, y_1^1, \dots, y_{n1}^1)$.

A3.4 COMPUTATIONAL LOGIC AND APPLICATIONS OF LOGIC

Wednesday, August 5 • 17:00–18:30
Main Building, Room 3

Hybrid Logic for Qualitative Reasoning about Location

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Spatial reasoning is one of the most interesting abilities that humans posses but can hardly reproduce by means of artificial intelligence algorithms. Human-like methods are usually less precise than artificial ones but, on the other hand, their practical results are far better and more universal than of any artificial system. At the intersection of logic and computer science there emerged a whole field of research called qualitative spatial reasoning (QSR in short) investigating methods that try to imitate or model human-like reasoning. In this talk, we present a hybrid modal framework for qualitative reasoning about location of objects in a flat 2-dimensional, subject-centered environment. In contrast to many existing qualitative approaches for reasoning about location, our system is devised to simultaneously capture intuitive notions expressing relative directions such as: to the right, to the left, behind, before etc., and qualitative distance relations like far or close. Furtheremore, since our approach is subject-oriented, it captures spatial representation in a human-like manner. The language of our Hybrid Logic for Qualitative Location (HLQL) is the basic hybrid multi-modal language (involving nominals and satisfaction operators) augmented with appropriately tailored accessibility relations and the constant symbol s (for the subject). The semantics for the logic is Kripke-structure based. A frame for HLQL is a plane, either finite or infinite, with polar coordinates, divided into cells of arbitrary length and angle-width. The central locus is occupied by the subject.

In the talk, we provide an axiomatization for HLQL and claim its soundness. We also show that, notwithstanding the PSpace -completeness of the basic hybrid multi-modal logic, the consequence of certain accessibility relations (like right and behind) causes the exponential blow-up of the computational complexity of HLQL raising it to NExpTime-hardness.

Contrary-to-Duty Imperatives: A Paraconsistent Deontic Approach

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Contrary-to-duty imperatives present an interesting take on deontology, and describes what a moral agent must do when she neglects her duties. In short, contrary-to-duty (CtD, henceforth) obligations are of the following form: "You ought to do a, but if you do not do a, then you must do b".

CtD imperatives turn out to be inconsistent if the actions a and b contradict each other. Modal deontic logic can express this situation. Yet, this contradiction trivializes the classical modal deontic logic. For that reason, we need to adopt a logical formalism that does not collapse under inconsistencies.

Paraconsistent logic suggests sound alternatives when moral obligations contradict each other. In this paper, we suggest a paraconsistent framework to express CtD imperatives. Our approach builds on some previously suggested paraconsistent deontic logics of da Costa and Carnielli.

The central contribution of this paper is to suggest a dynamic paraconsistent deontic logic to express CtD imperatives. The dynamic take helps us analyze how the model changes in a paraconsistent way when the moral agent neglects her initial obligation, and how the negligence of duties can be read as a dynamic update.

In order to achieve this, we syntactically define CtD as follows: "$C(p, q) \equiv Op \wedge \neg p \rightarrow Oq$", meaning that the agent is obliged to p, yet p is not the case, then she is obliged to q. If we assume the classical deontic axiom that $\neg(Op \wedge O\neg p)$ then C(p,q) produces a contradiction if q is taken as $\neg p$. This justifies the use of paraconsistent logic for CtD imperatives.

Based on this definition, we define updated models that satisfies the second obligation (here, q), and observe how CtD imperatives may benefit from a dynamic approach. Furthermore, we consider some frame properties if the underlying logic enjoys various additional frame properties.

Generalized Quantifiers and Higher-order Logic Programming

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We study the effects of incorporating generalized quantifiers in the bodies of program clauses in a higher-order logic programming language, such as the one introduced in [1]. We observe that there are some quantifiers (e.g., the existential) that keep the enriched language within the realm of computability, which is to say that the interpreter of that language is computable in the sense of Church-Turing thesis (i.e., it is a partial recursive function). However, there are quantifiers (e.g., the universal) such that the enriched language does not have a computable interpreter. Furthermore, among these quantifiers there are some that when used in the bodies of program clauses, define a language whose interpreter is not even representable (programmable in the generalized sense) in that language. A logic programming language that does not have an interpreter programmable in that language fails the so-called self-reflection property, which is one of the two fundamental properties of universal programming languages - the other being composition. We are concerned here with the effects of certain kinds of quantifiers, the so-called monotonic quantifiers, and we show that if we restrict the use to only those quantifiers, the enriched logic programming language retains not only the self-reflection property, but also that of composition. We also show that the interpreter of such a language is sound and complete with respect to the declarative semantics of the language. The results here are essentially a generalization of the results in [2] and [3], where we dealt only with the traditional first and higher-order logic programming languages.

[1] Miller and Nadathur, Higher-order logic programming, Third International Conference on Logic Programming, 1986. [2] Peter Gabrovsky, Logic programming with generalized quantifiers, Journal of Computing Sciences in Colleges, 2010. [3] Peter Gabrovsky, A recursion-theoretic semantics for higher-order logic programming, Fifth Southeastern Logic Symposium 1989.

A4

A4.1 HISTORICAL ASPECTS OF LOGIC / ANCIENT LOGIC

Tuesday, August 4 • 11:00–13:00
Main Building, Room 17

Why Does Formal Deductive Logic Start With the Classical Greeks?

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Many ancient peoples studied "logic" in the broad sense of persuasion, but the study of formal deductive validity starts with the classical Greeks alone. For some reason, the only person to invent a study of deductive validity in virtue of form was Aristotle, and all other logicians, everywhere in the world, have had his example to follow. How can this be? We argue that formal deductive logic emerged in classical Greece as a result of two crucial factors--one geographical, the other political. First, unlike other regions in the ancient world, classical Greece had a geography that favored small states, dominated by large urban crowds. The ease of navigating the Mediterranean Sea caused the commercial classes in the Greek cities to grow, and the small size of these states--a consequence of the many mountains and islands of Greece--meant that these same commercial crowds ended up dominating the politics of the classical age. As a result, political questions were settled, not by kings or small groups of nobles, but in mass meetings like the Athenian Assembly. And the mechanics of these meetings put special emphasis on public argumentation. Second, these same crowds, when called to make political decisions, often behaved irrationally. Such crowds had dominated the Athenian Assembly, but when Athens lost its long war against Sparta, and then followed this loss with the execution of Socrates, a reaction among intellectuals led to the development of formal logic. Philosophers focused increasingly on the difference between rational argumentation and irrational, and this theme, first developed by Plato but later expanded by Aristotle, culminated in the world's first known system of formal deductive logic. We attribute a change in intellectual history to aspects of political history, and we draw our argument from our recent book [title omitted for anonymous review].

Dialectical Games and the Origin of Logic CANCELLED

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I shall present, adapting some key ideas from modern game semantics (more precisely ideas from Lorenzen and Lorenz [6],[7]), a set of rules for Greek dialectic, also known as "antilogic" and "eristic", prior and up to Plato and Aristotle (for more details, see [3], [4]), and argue that the form the background from which logic emerged, with special focus on Aristotle's syllogistic. The point of view adopted here is inferentialist [1], [2], as it will be argued that Aristotle (and the Stoics) made explicit rules already followed in the practice of dialectic. Dialectical games, illustrated in Plato's dialogues (as well as Zeno's arguments on motion, Gorgias' ontological argument in his treatise On Not Being, but also later arguments such as the Sorites, etc.) and for which Aristotle's Topics and Sophistical Refutations form a manual, are thus seen as games between two players, called here "Answerer" and "Questioner", with Answerer asserting a thesis at the start and Questioner asking short yes/no questions meant to commit Answerer to a set of theses from which Questioner should be able to draw a contradiction, the "elenchos". In having thus both interrogative and logical steps, these games resemble Hintikka's "interrogative games", and the idea is that logic originates in making explicit the logical steps in the derivation of the contradiction [5]. Among topics to be covered are (a) the essential use of the principle of non contradiction, (b) the fact that, pace Vlastos [8], the "elenchos" is not a form of reductio ad absurdum proving A from the fact that not-A leads to a contradiction, given that the premises are only believed by Answerer (this is point of the doxastic constraint: "say what you believe"), and not known to be true, and (c) the important "Socratic" rule, according to which Questioner should never introduce one of the premises; otherwise it would not be Answerer that holds a contradictory set of beliefs. This last rule, related to the "Formal Rule" in dialogical logic, is amply motivated by Socrates' notorious "avowals of ignorance". A specific example of making explicit a rule will be discussed (as part of joint work with H. Rückert), the rule of the universal affirmative ("All A is B") in Topics VIII, 2, 157a34-157b2, which is implicitly used, for example, in Hippias Minor 366c-369b. It involves induction ("epagoge") and it is related to the dialogical rule for the universal quantifier This is in turn at the origin of the all important meaning explanation of the universal affirmative in Prior Analytics I, 2, 24b28-29, according to which "All A is B" means that no "a" of type "A" can be found which is a "B", and which is usually understood merely in terms of the absence of counterexample. This dialectical origin also explains the existential import, given that an universal affirmative always come into play after a few instances have been conceded.

[1] R. Brandom, 'Asserting', Noûs, vol. 17 (1983), 637–40. [2] R. Brandom, Making It Explicit. Cambridge, MA: Harvard University Press, 1994. [3] B. Castelnérac & M. Marion, 'Arguing for Inconsistency: Dialectical Games in the Academy'. In G. Primiero & S. Rahman (eds.), Acts of Knowledge: History, Philosophy and Logic. London: College Publication, 2009, 37-76. [4] B. Castelnérac, M. Marion, 'Antilogic'. Baltic International Yearbook of Cognition, Logic and Communication, vol. 8 (2013). (Electronic publication) [5] J. Hintikka, 'Socratic Questioning, Logic and Rhetoric'. Revue internationale de philosophie, vol. 47 (1993), 5-30. [6] P. Lorenzen & K. Lorenz, Dialogische Logik. Darmstadt: Wissenschafstliche Buchgesellschaft, 1978. [7] H. Rückert, Dialogues as a Dynamic Framework for Logic. London: College Publications, 2011. [8] G. Vlastos, 'Socratic Elenchus: Method is All'. In Socratic Studies. Cambridge: Cambridge University Press, 1994, 1-37.

Negation and truth in Greek mathematics and philosophy

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Historians of mathematics assume classical semantics and classical theory of truth in their studies of Greek mathematics. However, there is no trace of any concept of negation in the Pythagorean version of arithmetic, even in its elaborate expositions by Neo-Pythagorean authors (Nicomachus, Theon, and others). This concerns affirmative sentences stating something 'positive' that can be confirmed by means of the construction of some configuration. No statements postulating the existence of a number identified by a negative property (or lack of a property), or statements asserting the impossibility of a construction is ever formulated in the extant sources [Vandoulakis 2010].

Negation is neither found in the texts of Hippocrates of Chios on the quadrature of the lune, quoted by Simplicius. Hippocrates' visual mode of notation, that does not actually names geometrical objects, but serves as an index or marker indicating concrete geometrical objects is not compatible with an abstract concept of negation. Nor is found in Book II of Euclid's Elements, which is considered of early origin. Negation is also alien to Parmenides. His ontological universe is a positive true Being, lacking negative facts. It was Plato who first examined the structure of simple statements and defined negation in a way close to the concept of logical negation, irrespectively of their linguistic expression by the two Greek words: me or ou. Euclid in his Elements deliberately uses both these forms as logical negations in the style of Plato. Consequently, we have to adopt the periodization standardly used in history of Greek philosophy to define a period of early Greek mathematics in sharp distinction to the subsequent classical Platonic era. During this period, both mathematics and philosophy lack a concept of negation and negative fact, and thereby a classical theory of truth, that were later developments by Plato and Aristotle [Wolenski 2004].

References: Vandoulakis I.M. 2010. "A Genetic Interpretation of Neo-Pythagorean Arithmetic," Oriens - Occidens Cahiers du Centre d'histoire des Sciences et des philosophies arabes et Médiévales, 7, 113-154. Wolenski, Jan 2004. "Aletheia in Greek thought until Aristotle", Annals of Pure and Applied Logic 127, 345.

Redundancy and the Stoic Themata

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The most striking aspect of the Stoic notion of validity is their claim that redundant arguments are invalid. This, interpreted correctly, means that the consequence relation approximating the stoic notion of validity is not only non-monotonic, but anti-monotonic. Adding a single premise, relevant or irrelevant, to an otherwise valid argument results in an invalid argument. This claim is so alien to modern logicians that reconstructions of the proof system of the Stoics have either ignored it, claimed that the ancient sources on Stoic logic (largely opponents like Diogenes Laertius or peripatetics like Alexander of Aphrodisias) were simply mistaken, or significantly weakened the restriction, claiming only that the Stoics had some notion of relevance in mind.

I think that each of these courses is mistaken. I introduce the basics of the Stoic notion of validity, argue for a straightforward and literal interpretation of the rejection of redundant arguments against other interpreters, show how prior reconstructions violate this constraint, show how to give a partial reconstruction which accommodates all the evidence we have as to the nature of Stoic logic, and discuss some problems in understanding the Stoic notion of validity. I draw no firm conclusions about the Stoics's notion of validity, but suggest some reasons to think that comparisons with modern conceptions of validity are misleading. And I close by putting forward two more plausible, though not unproblematic, interpretations of Stoic validity---one in terms of the notion of in virtue of or grounding, the other tied to a formal dialectical game---and argue that fruitful research on Stoic validity will proceed down one of the two paths.

A4.2 HISTORICAL ASPECTS OF LOGIC

Wednesday, August 5 • 11:00–13:00
Main Building, Room 14

The Logic of Avicenna between al-Qiyās and Mantiq al Mashriqiyīn

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Avicenna's logic is presented in commentaries of Aristotle, such as *al-Shifā, al-Qiyās* (*Prior Analytics*). But the treatise entitled *Mantiq al-Mashriqiyīn*, seems to differ from the preceding and is said to express Avicenna's own logical theory by some commentators. So the problem is the following: Is this treatise in conflict with *al-Shifā*? What are the differences between them?

In this contribution, we will try to answer these questions by comparing between the opinions defended in these treatises with regard to the analysis of the categorical propositions. We will show that there is no radical difference between these analyses, since some of the new ideas developed in the last treatise can already be found in *al-Qiyās*. The absolute propositions are divided, in *al-Qiyās*, into several kinds depending on the conditions they contain, which are temporal for some of them and descriptional for others. This classification becomes the following in *Manṭiq al-Mashriqiyīn*: 1a: S is P (as long as S exists), 1b: S is P (as long as it is S); 2/ Factual (*Ṭāri'a*): S is P (not perpetually); 3/ Determined (*mafrūḍa*): S is P (in some determined time), 4/ Spread (*muntashira*): S is P (in some undetermined, but regular times), 5/ Temporal (*waqtīya*): S is P (at present). This classification differs from that of *al-Qiyās*, since some propositions, such as those containing 'as long as it is P' and 'always' are no more cited, (1a) and (1b) are grouped here, while they are separated in *al-Qiyās*, but we find nevertheless many common points, for (3), (4) and (5) are already present in *al-Qiyās*. Thus, there is a real continuity between both treatises, for the temporal analysis of the propositions initiated in *al-Qiyās* is developed more systematically in *Manṭiq al-Mashriqiyīn*.

Non normal modal logica in Thomas Aquinas

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The paper examines Aquinas's analysis of future contingents. Aquinas maintains that if God knows that "p" (where "p" is a proposition), then "p" is the case. I maintain that Aquinas believes that for every "p", if God knows "p", then necessarily (God knows that "p").In virtue of the K axiom (⊨ (A→B)→(Necessarily: A → Necessarily: B)), it would follow that propositions expressing future contingents cannot but be necessity propositions. Hence, Aquinas would not have any theory of future contingents, because all future events would be described by necessity propositions. This, however, is not the case. There is textual evidence to claim that Aquinas subscribed to an impossible worlds semantics for his modal logic. The textual evidence consists in Aquinas's analysis of the Principle of Non Contradiction, where Aquinas maintains that contradictions can be expressed, even though, he adds, they cannot be thought: these 'expressions' are clearly impossible worlds; when Aquinas adds that contradictions cannot be thought, he is not subscribing to any normal modal logic, but is rather expanding, in my interpretation, a psychological feature of human brains. Aquinas maintains that God also knows 'imaginabilia'. Among things that can be thought of, there is the denial of the PNC (e.g.: Aquinas discusses the case of the destruction of the past, which denies, in his view, PNC). Therefore, God knows also 'impossible worlds' in which logical truths (like the PNC) are not necessary truths. Within this semantic framework, K is not an axiom. Therefore, Aquinas can consistently account for future contingents, by claiming that they are contingent 'de re', but not 'de dicto' in the proposition 'if God knows "p", then "p" '(where "p" is a proposition that describes a future contingent event).

Richard Kilvington and the Theory of Obligations

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Kretzmann and Spade were led by Richard Kilvington's apparent revisions to the rules of obligations in his discussion of the 47th sophism in his Sophismata to claim that the purpose of obligational disputations was the same as that of counterfactual reasoning. Angel d'Ors challenged this interpretation, realising that Kilvington's objection was precisely that he found the art of obligation unsuited to the kind of reasoning which lay at the heart of the sophismatic argument. He realised that the way irrelevant propositions are treated in obligations can lead to unwarranted inconsistencies when employed outside their natural home. In his criticism, Kilvington focussed on a technique used by Walter Burley to force a respondent to grant an arbitrary falsehood similar to Lewis and Langford's famous defence of ex impossibili quodlibet. Kilvington observes that just as in obligational disputation, one may be obliged to grant a false proposition and deny a true one, so in counterfactual reasoning one may be obliged to doubt a proposition whose truth or falsity one knows, on pain of contradiction. However, rather than proposing simply to revise the rule for irrelevant propositions, Kilvington is best understood, as argued by d'Ors, as proposing to set aside the common practice of obligations and to realize that in reasoning about counterfactual situations one cannot separate relevant propositions from irrelevant in the usual way. For seemingly "irrelevant" propositions would take a different truth-value if things were as signified by the positum. Consequently, far from obligations having the aim of modelling counterfactual reasoning, as suggested by Kretzmann and Spade, they are inconsistent with that aim and unsuitable for its prosecution.

CONTRIBUTED PAPERS / A4.2 HISTORICAL ASPECTS OF LOGIC

Aristotelian Diagrams for Multi-Operator Formulas in Avicenna and Buridan

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It is well-known that the categorical statements from syllogistics have modal versions, such as "all men necessarily run". The fourteenth-century philosopher John Buridan showed that the Aristotelian relations holding between such formulas do not yield a classical square of oppositions, but rather an octagon (see the work by Stephen Read and others). The Aristotelian relations holding between formulas that involve a quantifier and a modality were already studied by Avicenna in the eleventh century (although he did not actually draw an octagon). Furthermore, it has recently been shown by Saloua Chatti that Avicenna extended this analysis in two directions by considering more fine-grained quantifiers and modalities (such as those in "some but not all men necessarily run" and "all men possibly but not necessarily run") and thereby obtained two 12-formula analyses. In this paper, we will examine how these analyses are connected to each other, and present one further extension, in which all other analyses are integrated. We start by "decomposing" Buridan's octagon into two independent squares: one for the quantifiers (all, some, no, not-all) and one for the modalities (necessary, possible, impossible, not-necessary). The "product" of these squares yields 4x4=16 pairwise equivalent formulas, and is isomorphic to the octagon. Next, we move to the Boolean closure of these squares, by adding two quantifiers (some-and-not-all, all-or-no) and two modalities (possible-and-not-necessary, necessary-or-impossible), thereby obtaining a quantifier hexagon and a modality hexagon, respectively. We now consider the "product" of the quantifier hexagon with the modality square, and that of the quantifier square with the modality hexagon: these consist of 6x4=4x6=24 pairwise equivalent formulas, and correspond exactly to Avicenna's two 12-formula analyses. Finally, one can also consider the "product" of the two hexagons, which consists of 6x6=36 pairwise equivalent formulas, and which subsumes all previous analyses in an octadecagonal diagram.

A4.3 HISTORICAL ASPECTS OF LOGIC

Friday, August 7 • 14:30–16:30
Main Building, Room 17

Individual Names and Identification in Late Medieval Epistemic Logic

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In late medieval times, epistemic logic was treated as an extension of modal logic. A widely discussed question pertained to epistemic consequences with demonstrative pronouns or proper names. Some medieval problem sentences and their analyses are of the same kind as those discussed in contemporary epistemic logic. After a brief survey of these matters, I would like to discuss the differences between two influential fourteenth-century approaches.

In his On Knowing and Doubting, William Heytesbury writes: "For in the divided sense a consequence of this sort is perfectly valid: 'This I know to be running, and this is Socrates: therefore Socrates I know to be running'; analogously, 'This I know to be true, and this is A; therefore, A I know to be true' ... for the inference is an expository syllogism." (De scire et dubitare, 3rb).

John Buridan summarizes his analysis of epistemic problem sentences as follows: "The whole difficulty turns on whether this follows: 'I know some star to be above our hemisphere; therefore, some star I know to be above our hemisphere' ... And if it were asked whether of the sun he knows that it is above, I would say yes, if the sun is above, and no, if it is not. Therefore I concede that although of the sun he knows that it is above, still he does not know whether of the sun he knows this." (Summulae de dialectica 901-902)

While agreeing to the de re conclusion of the expository syllogism in Heytesbury's example, namely $\exists x(x ? s \wedge KaFx)$, Buridan argues, as distinct from Heytesbury's followers, that this follows whenever a knows de dicto about things of which one is s, whether a knows this or not. Why did others not accept this?

John Foxholes's Tractatus de propositione per se nota. Reconstructing the scotistic debate on the status of axioms.

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John Foxholes' 15th-century treatise on propositiones per se nota (a priori propositions, axioms) has failed to attract the interest of scholars of the period. However, the treatise is a privileged object of study in the reconstruction of Duns Scotus's and other scotistic positions within the debate on the status of axioms. The main theme of the treatise is to see whether a priori propositions can be known without having distinct knowledge of the terms constituting this proposition. Foxholes answers in the affirmative by repeating Franciscus Mayronis's criticism of Petrus Aureoli's position. Within the subordinated sciences, axioms are known through comprehension of their constituting terms, the terms in turn referring to objects. However, to know an object is to know its essence or ratio, which is not the case in the subordinated sciences. Only in metaphysics objects are studied according to their essence. Therefore, Petrus Aureoli's opinion - who held that the subordinated sciences include the knowledge of a priori propositions - is false. This criticism is tied up with another of Mayronis's theses. The evidence for the truth of an a priori proposition has to be given intrinsically, thereby excluding the possibility that the truth of these propositions can be known through anything else than through the knowledge of the constituting terms. One can therefore conclude that an axiom can be known in two ways: metaphysically through the knowledge of the essence of the things that the terms refer to, or through the knowledge of these terms alone. According to Foxholes, this solution is given by Nicolas Bonetus: propositions can be known either through "opinion" (terms) or "science" (essence). To conclude, Foxholes presents a development within scotistic thought that seems to adopt a distinction between the relative and absolute truth of axioms, tied up with the subordination of the different sciences.

Descartes' Logic and the Paradox of Deduction

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Descartes is among the many philosophers who have noticed an apparent conflict between the validity of logical deductions and their usefulness. If the conclusion is not somehow contained in the premises, the deduction is not valid. If, on the other hand, the conclusion is contained in known premises then the conclusion is also known. This means that any deductive steps which help us arrive at that conclusion must be superfluous, for they can only produce something that is already known to be true. We can call this the Paradox of Deduction.

The Paradox of Deduction arises in the context of modern formal logic, but it is also a problem for the syllogistic logic employed by the Scholastics. Descartes in his Rules for the Direction of the Mind used a version of the Paradox to argue that syllogistic logic is useless for helping to expand the scope of our knowledge; it is, at best, a tool for presenting results obtained by other methods. Descartes' own logic is psychologistic and informal insofar as a good deduction requires that each step in a deduction be perceived as certain as one proceeds from premises to conclusion. And it purports to resolve the Paradox of Deduction by explaining how a previously uncertain conclusion can be made certain by performing a deduction.

This paper extends the existing literature on the subject by providing a new interpretation of how, in Descartes' logic, the conclusion is contained in the premises. The key is to locate a component of content that is identically present in every step of a successful deduction. An additional benefit of the interpretation is that is explains how the steps in a deduction are necessarily connection to one another.

Kant's Influence on the Herbartian Conception of Logic

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In the early 1830s, there arose a lively discussion concerning the possibility and the justification of logic not only as a philosophical discipline, but also as the formal and fundamental theory of science which might clarify not only the logical, but also the metaphysical foundations of science. The reform of logic was sought from different directions both by philosophers and mathematicians. On the one hand, many participants opposed Hegel's attempts to unite logic and metaphysics – on the other, reform was sought in order to overcome the old Scholastic-Aristotelian tradition of logic. As the discussion moved on, it became commonplace to accept the idea that the possible reform of logic must go hand in hand with the reform of philosophy. The Kantian appreciation of mathematics against its Hegelian devaluation became rehabilitated even though the question about the relationship between logic and mathematics remained a difficult one.

The 19th century discussion concerning the reform of logic can be properly understood only by first discovering the relations between logic and philosophy at that time. During that time the reform of logic was quite generally regarded as a philosophical issue. Therefore perhaps the best way of approaching these developments is to begin with clarifying Kant's conception of logic in the overall framework of his critical philosophy. The focus of my presentation is on the early and mid-19th century Herbartian interactions between philosophy and logic. First, I discuss the nature and the place of formal logic in Kant's philosophy. Kant's division of logic into its general and transcendental parts had an important influence on the disagreements between the Hegelian metaphysical idealists and the Herbartian empirical realists. This conflict of opinions was the most important source of different early and mid-19th century attempts to find a reform in the field of logic.

I aim to show that the revolutionary development of logic during the 19th century can only be understood properly by relating its emergence to the preceding philosophically-oriented discussion on the reform of logic.

A4.4 HISTORICAL ASPECTS OF LOGIC

Thursday, August 6 • 14:30–16:30
Main Building, Room 17

Philosophical and Mathematical Correspondence between Gottlob Frege and Bertrand Russell in the Years 1902-1904. Some Uninvestigated Topics

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Although the connections between Frege's and Russell's investigations are commonly known (Hylton 2010), however, there are some topics in the letters which do not seem to have been analysed until now: 1. Paradoxes formulated by Russell on the basis of Frege's rules: a) „»ξ can never take the place of a proper name« I false proposition when ξ is a proposition";

b) "A function never takes the place of a subject". A solution of this problem was based on reference/sense theory and on distinction between the first- and second-level names (Frege). 2. The inconsistency in Frege's system may be avoided by introduction of: a) a new kind of objects called quasi-objects (Frege); b) logical types (Frege and Russell); c) mathematics without classes (Russell); d) some restrictions on domain of function (Frege). 3. Since an inconsistency is connected with a class what is class? In one of the letters Frege compared a class to a chair which is composed of atoms. It seems to be similar to collective understanding of a set (Stanislaw Lesniewski). 4. Russell doubted that the difference between sense and reference of expressions is essential. Hence, Frege found some additional reasons to distinguish them: semiotic, epistemological, from identity, from mathematical practice. This discussion can be seen as a starting point to Russell's theory of description.

G. Frege: Nachgelassene Schriften und wissenschaftlicher Briefwechsel. Band 2: Wissenschaftlicher Briefwechsel. Hrsg G. Gabriel. Hamburg Meiner, 1976 (2013). P. Hylton: Frege and Russell. In; The Companion to Frege. Eds. M. Potter, T. Ricketts. Cambridge University Press 2010, pp. 509-549.

A Puzzle About Frege's Singular Senses

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My purpose in this paper is both exegetical and critical: I want to discuss Frege's view on the senses ("Sinn") of singular terms (which I also call singular senses), i.e., how they are formed and what is their structure. It is exegetical because I will stay as close as possible to Frege's writings in extracting his exact view from them. And it is critical because, as I will argue, a surprising incoherence appears along the way. I start by reviewing some well known elements of Frege's doctrine of sense and reference. As I intent to show, when these well known elements are brought together in a non-standard way, a puzzle seems to emerge regarding singular senses: where does their saturation come from? There are some proposals in the literature and I shall review the most important of them, but each one seems either to be directly incompatible with other things that Frege says or to betray the spirit of the Fregean notion of sense. Frege says remarkably little about the senses of singular terms; one can find only few scattered remarks about this topic in his writings. But some things that he does say suggest an approach to singular senses that is blatantly incompatible with the rest of his semantics. So, my conclusion will be that, for all the elegance and epistemic advantages of the Fregean notion of sense, he has no coherent view on the senses of singular terms. This might be alarming, for these are supposed to be the most simple and basic senses from an epistemic point of view. And, given the complementarity of senses of singular terms and of predicates, the incoherence might infect the latter notion as well (and, a fortiori, the notion of sense as a whole).

Gottlob Frege and the school of Brentano.

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A number of Frege's ideas look as if he was very close to the Austrian tradition in logic and philosophy, and the hypothesis that Frege was influenced essentially by the school of Brentano might be considered as a much credible one.

In his first revolutionary work, Begriffsscrift (1879), Frege suggests the theory of judgment, which is strikingly relative to Brentanian one. This kind of treatment the judgment was not practiced by anybody else except these two authors.

In his next seminal work, Die Grundlagen der Arithmetik (1884), Frege draws strict distinction between concept and object. The accentuation on this distinction is a specific feature right of Austrian (not only Brentanian) philosophical community.

In 1891 Frege examined the work of another one member of the Brentano school, Benno Kerry. Kerry refers regularly not only to the statements of Brentano and his disciples, but also to the citations of Bolzano. More than once he refers to Bolzano and Frege in the same footnote. The paper of Kerry the noteworthy reasoning: «The remarkable advantage of conceptual representations against intuitive one consists in the fact that several completely different may refer to one and the same object...: 'the chancellor of the German Reich in 1884' and 'the owner of Warzin in 1884' refer to one and the same person".

The idea that different (contents of) concepts might correspond to the same object was rather habitual for the school of Brentano and served as a subject of hot discussions.

Another student of Brentano, Anton Marty, who was in correspondence with Frege, in 1884 states that there necessarily must be given some mediating link between language expression and its denotation (bedeutung). Moreover, he remarks that this mediator serves as "the way by which signs are denoting", and expands his considerations of denoting from names to sentences.

Chomsky, Wittgenstein, Frege and the Formalists: A Dispute Concerning Meaning

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Wittgenstein and Chomsky are commonly perceived as defending radically different conceptions of meaning. Whilst Wittgenstein is often interpreted as being an externalist about meaning and mental content, Chomsky is considered a notorious advocate of internalist semantics. Whilst this picture may be correct to some degree, and subject to important qualifications, I argue that it largely rests on misunderstandings, both of Wittgenstein and of Chomsky. I aim to challenge the received view by presenting an argument for an internalist reading of Wittgenstein's use conception of meaning.

The paper focuses on the aspect of Wittgenstein's work that thus far failed to receive sufficient scholarly attention although it plays a vital role in the development of Wittgenstein's view of linguistic meaning after the Tractatus. In particular, the focus will be on Wittgenstein's objections to Frege's arguments against the formal arithmetic of Heine and Thomae, where Wittgenstein's anti-externalism about meaning is most clearly articulated and defended. I shall argue that Wittgenstein's main problem with Frege's conception of logic and arithmetic concerns its underlying externalist semantics and problematic ontological commitments such construal of semantics typically entails.

After explaining Frege's theory of meaning and his critique of radical formalists in Grundgesetze, I systematically examine Wittgenstein's objections to Frege, focusing in particular on issues to do with the non- arbitrariness of arithmetical rules and the applicability of arithmetic. I argue that, despite its prima facie similarity to the initial formalist proposal, Wittgenstein's critique of Frege's externalism results in a novel conception of meaning. Instead of identifying meaning with the objects denoted by signs, Wittgenstein suggests that meaning lies in the instructions or rules that detail the procedures for the manipulation of symbols in a formal system. This idea, in contrast to Frege's, is perfectly compatible with Chomsky's semantic internalism.

A4.5 HISTORICAL ASPECTS OF LOGIC

Saturday, August 8 • 10:00–12:00
Main Building, Room 17

Anton Marty and the semantics of names

Aho Tuomo
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One of the famous issues in philosophical logic and philosophical semantics in the twentieth century has been about the meaning and reference of proper names. There are, roughly, two main parties: descriptive theories, which characterize the meaning of term with descriptions, and non-descriptive theories (with causal theories of reference as a prominent case). Descriptive theory was consciously formulated first by Frege and Russell, whereas the non-descriptive alternative became the focus of debate after Kripke. Considering this subject, it is interesting to note that there was a similar discussion already much earlier. Anton Marty, the philosopher of language of the Brentano school, studied names in his Untersuchungen (1908). The argument he gave were later elaborated by Landgrebe in his criticism of the linguist Ammann, who held a

practically Kripkean view. Marty admits the causal origin of the use of names, but emphasizes that this shows nothing about their meaning. He attempts to utilize the results of medieval logic and Brentano to show that a name must have also a significative content, and this cannot be purely psychological. Marty defends a consistently descriptive position, but realizes also that it is not unproblematic but requires more thorough analysis. Here he improves Frege by claiming that the field of possible determining descriptions is basically indefinite and not sufficient for logical identification, and it varies according to language-users and contexts. His remarks about possible

descriptions touch a couple of rather subtle questions which reappeared in the 1980s. An obvious problem for Marty's approach concerns the communication between people who join different descriptions to the names they use. In this issue, Marty comes close to some ideas later developed by Grice.

Leon Chwistek (1884-1944) and his Constructive Type Theory

Bozek Hubert
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In my paper I wish to discuss some aspects of the Constructive Type Theory (CTT) first formulated in 1922 by a polish logician, philosopher and painter, Leon Chwistek (see: Chwistek, 1922, 1923, 1924) The focal point of Chwistek's criticism of the classic Eextended Type Theory, was the Axiom of Reducibility, adopted by Russell (see: Russell & Whitehead, 1910, p.): (∃?) [?!(x, y) ? x, y ψ (X, Y)] stating that for any predicative function ?! there is a corresponding formally equivalent propositional function ψ. The philosophical ratio for that rejection on the part of Chwistek was the conviction that the axiom in question contains an ad hoc existential supposition, which in turn contradicted his logicist approach in the foundation of mathematics. The affiliation to logicism was dictated by certain ideal of rationality, which I will briefly present.

According to Jan Wolenski the CTT by Chwistek is "the formally most perfected" example of logicism (see: Wolenski, 1987, p. 145). At the same time, it clearly demonstrates how strongly is the work of a logician influenced by his/hers philosophical background. These last two statements combined together lead to the question, of whether logicism can indeed be upheld, let alone form a logico-philosophical point of view (not to mention matehematical or metamathematical perspective), for if it assumes any grounds other than logical for adopting or rejecting propositions, can it still be justifiably called logicism? Arguing from the case of Chwistek I wish to present the preliminary answer to this question.

Literature: Chwistek, Leon: Theory of Constructive Types [in] "Rocznik Polskiego Towarzystwa Matematycznego", pt.. I, II, (1923), pt.. III (1924). Russell, Bertrand; Whitehead, Alfred North: Principia Mathematica, Cambride: Cambridge University Press, 1910. Wolenski, Jan: Krytyka rozszerzonej teorii typów logicznych we wczesnych pracach Leona Chwistka [w] Ruch Filozoficzny" ,t. XLIV nr 2. (1987).

On some unknown ideas by Sobocinski: comments on philosophical applications of Lesniewski's systems

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Logic, Cardinal Stefan Wyszynski University, Warsaw, POLAND
Porwolik Marek
Methodology of Science, Cardinal Stefan Wyszynski University, Warsaw, POLAND

Boleslaw Sobocinski was a close collaborator of Stanislaw Lesniewski and a consequent propagator of his protothetics, ontology and mereology. In relation to these interests, Sobocinski worked on new formulations of these systems and their axiomatisations. Some of his results were published and confronted with Lesniewski's original formalism, however we also know of the existence of papers devoted to these ideas, which were lost during the Second World War (as was the case with his development of protothetics). In connection with ongoing historical research, the authors present some unknown results formulated by Sobocinski and described in correspondence with J. M. Bochenski in the late forties and early fifties of the twentieth century (few comments on these letters were already made by Jan Wolenski). Unpublished archival material will be compared with published texts of Sobocinski, especially those focusing on ontology and mereology. Our comparative analysis will be linked to the original philosophical views of Lesniewski. In particular, we will consider his argumentation against the possibility of the existence of universals in connection with its formalization by Sobocinski, as given in the original new formal frame of Lesniewski's ontology. Secondly, certain ideas of Sobocinski on applying mereology to theodiceal qestions will be discussed.

Bibliography: 1. Lesniewski S., "Krytyka logicznej zasady wylaczonego srodka", [Critique of the Logical Principle of Excluded Middle], Przeglad Filozoficzny, 16 (1913), 315–352. 2. Sobocinski B., „O kolejnych uproszczeniach aksjomatyki „ontologii" prof. S. Lesniewskiego" [Next simplifies of axiomatics of prof. S. Lesniewski's „ontology"] In: Fragmenty filozoficzne. Ksiega Pamiatkowa [...] prof. Tadeusza Kotarbinskiego [Philosophical Fragments. Commemorative book for [...] prof. Tadeusz Kotarbinski],1934. 3. Correspondence between Sobocinski and Bochenski, archival material. 4. Wolenski J., Szkola lwowsko-warszawska w polemikach [Lvov-Warsaw School in Polemics], Scholar, Warsaw 1997

Gentzen's 'Finitist' Interpretation in the Context of the Formalism-Intuitionism Controversy

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Kreisel, in his review of the collected papers of Gerhard Gentzen by edited Szabo, had thrown light on the following aspect of Gentzen's first (posthumously published) consistency proof: to assign a 'finitist' sense to each theorem of classical arithmetic. After Kreisel's remark, several studies have been made on this 'finitist' interpretation, which is often thought to be a precursor of the method of extracting constructive contents from proofs of classical arithmetic. In the present paper, we put this interpretation in the historical context of the formalism-intuitionism controversy. Specifically, we aim to achieve the following three objectives. First, we explain that the 'finitist' interpretation by Gentzen's first proof had the role of responding to intuitionists' objection against the significance of formalist consistency proofs. The objection runs as follows: formalist consistency proofs for classical mathematics are of no significance, because its theorems remain meaningless even if such proofs are given. Second, we argue that the role of responding to the intuitionistic objection can be found in Hilbert's methods of consistency proofs as well. It can be found not only in the method of consistency proofs invented by Hilbert's Program but also in the method of 'semantic' consistency proofs presented by the later paper "Beweis des Tertium non datur"(1931). Finally, by examining Sieg's analysis of Gentzen's unpublished manuscripts, we claim that Gentzen in fact inherited the above role of consistency proofs from Hilbert. Achieving these objectives, we attempt to take a step toward an explanation for the historical background of Gentzen's 'finitist' interpretation.

B1

B1.1 METHODOLOGY

Tuesday, August 4 • 11:00–13:00
Main Building, Room 13

Definitions: Eliminability and Conservativeness

Zouhar Marian
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Definitions – qua explanations of meanings of expressions – are usually divided into lexical and stipulative ones. Lexical definitions report the actual meanings of expressions, while stipulative definitions propose new meanings. The received view has it that a definition is good provided it satisfies the criteria of eliminability and of conservativeness (one of the best expositions can be found in N. Belnap, "On Rigorous Definitions," Philosophical Studies 72, pp. 115-146). In his handy formulation motivating the criteria Belnap has pointed out that a definition should explain all the meaning of an expression and should do only this (p. 119). According to the former criterion, definiendum can be replaced by definiens in any (sentential) context without any change in. According to the latter criterion, a context involving the definiens cannot be used to infer more information than the corresponding context involving the definiendum.

The aim of the talk is to argue that the two criteria cannot be equally well applied to both kinds of definition. Firstly, stipulative definitions can be treated both as eliminable and conservative. It will be argued, moreover, that they cannot but be eliminable and conservative. Secondly, it will be argued that the situation is reversed in the case of lexical definitions. In general, they can be neither eliminable nor conservative. Concerning eliminability, if the definiens is supposed to be an explication (in Carnap's sense) of the definiendum, the latter cannot be replaced by the former in all contexts without any harm. Another bunch of problems arises when the definiendum has multiple meanings. Concerning conservativeness, a number of authors claimed that lexical definitions should be fruitful meaning that they cannot explain only all the meaning expressions have. I elaborate further on this line of argument by discussing certain kinds of relation obtaining between definiendum and definiens.

Contexts for philosophy: How can novel contexts in synthetic biology help philosophy of science?

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Synthetic biology is a novel interdisciplinary field that combines the expertise of biologists and engineers among others. There is, however, some worry coming from philosophical discussion and from our collaboration with synthetic biologists as to what exactly is philosophically new or interesting in synthetic biology? We argue that synthetic biology can be used as a source of concrete examples that provide a more fine-grained analysis of questions of philosophy of science, as well as offer new insight on the question of interdisciplinary collaboration.

To start off, we provide some general remarks concerning the philosophical relevance of case studies and examples. In particular, we analyze how in philosophy of science concrete examples can be used to contextualize and elaborate philosophical ideas. In this manner, new fields like synthetic biology can provide new contexts for philosophical analysis. These novel contexts can provide constraints through details for philosophical questions, and may lead to reconceptualization of these questions as well as bring about novel ones.

In this spirit, we provide an example of such a context in synthetic biology: the difference between engineers and biologists in terms of how they conceptualize and form their systems. Engineers seek to specify their systems to such a degree that the system behavior can be effectively predicted and controlled. Biologists on the other hand tend to focus on more general features of the system and are happy to leave in unspecified parts. Philosophical analysis of contexts can help alleviate these tensions and provide valuable philosophical insights to the methodology of science. This has relevance for successful interdisciplinary collaboration in synthetic biology.

A Hessian Approach to Analogical Reasoning in Theory Construction

Chen Ruey-Lin
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Bolduc Jean-Sebastien
Laboratoire de Biométrie et Biologie Evolutive, Université Claude Bernard Lyon 1, Lyon, FRANCE

In the philosophy of science, with a few exceptions, works on analogy have been relatively few since Mary Hesse's classic work, Models and Analogy in Science. The goal of this paper is to combine a theoretical framework with a detailed analysis of historical cases and to explore the role of analogy in (scientific) theory construction. In this paper, we use Hesse's original understanding of analogical reasoning to develop a related framework. We call it Hessean approach. Give there are many approaches such as the probabilistic, the cognitive, and the computational ones, we select Hesse's approach for two main reasons: First, by a preliminary comparison with the other approaches, we think that Hesse's approach is more natural than others are. Second, Hessean approach is more suitable for investigating the role of analogical reasoning in theory construction than other approaches are. In order to sufficiently exploit the potential of Hessean approach, our framework revises Hesse's original in the two points: First, we drop the "formal" and "material" name tags, and view analogy as both the structural correspondence and pretheoretic similarities between two analogues. Second, we develop three new symbolic schemas by modifying and extending Hesse's original schema. In order to show the virtues of our framework, we illustrate our proposal through the analysis of two famous case studies: the construction of Coulomb's law and the construction of Darwin's theory of evolution by natural selection.

A Frame-Based Approach for Operationalized Concepts

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According to a seminal paper by Lawrence W. Barsalou (1992), frames are attribute-value-matrices for representing exemplars or concepts. Furthermore, frames have been proven to be a very useful tool for reconstructing scientific concepts as well as conceptual change within scientific revolutions as a field of interest for philosophers of science. In frame-based representations of scientific concepts developed so far the semantic content of concepts is (partially) determined by a set of attribute-specific values. In addition to the semantic content of concepts, frames can also contain empirical knowledge that is represented as constraints between the values of the frame. This way of representing concepts works best for prototype and well-defined concepts.

Beside prototype and well-defined concepts, in science operationalized concepts play an important role. However, so far no frame-based representation of operationalized concepts has been developed. In my talk, I will show that frame-based representations of defined and prototype concepts have a different structure than frame-based representations of operationalized concepts. In order to explicate this difference in structure, I will develop a frame-based method for representing prototype, defined, and operationalized concepts by means of mathematical graph-theory. Proposing that frames are mathematical graphs will provide a frame-based explication of the difference between prototype, defined, and operationalized concepts including all advantages of frame-based representations in general. One important consequence will be that the constraints of a frame representing an operationalized concept are entailed by the structure of the frame as opposed to a frame representing a defined or a prototype concept. In order to illuminate the idea of operationalizing frames, I will introduce a multiple operationalized concept of the linguistic theory of generative grammar according to N. Chomsky and provide a frame-based representation of this concept.

B1.2 METHODOLOGY

Tuesday, August 4 • 14:30–16:30
Main Building, Room 17

The Challenges of Incommensurability to Comparative Philosophy

Wang Xinli
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The talk is intended to show that the issue of incommensurability of two scientific languages / theories as discussed by Thomas Kuhn and others in the philosophy of science can be fruitfully applied to and shed light on comparative philosophy.

Comparative study between Western and Chinese philosophy has become a new trend of philosophical fashion of 21st century. The recent success of many fruitful comparative studies between Western Philosophy and Chinese philosophy seems, for many comparative philosophers, has put the threat of cultural relativism to the viability of comparative philosophy to rest. Does cultural relativist conviction--that is, there are incommensurable conceptual and cultural schemes through which distinct cultures construct their own worlds and which inevitably lead to the cross-cultural communication breakdown between them--no longer pose a mortal threat to the viability of comparative philosophy? I tend to believe otherwise and intend to show here that the incommensurability between the two cultural/intellectual traditions continues to impede the effort of comparative philosophy.

My suspension with the viability of comparative philosophy between two radically distinct cultural/intellectual traditions, like Western and Chinese philosophy, starts with the unavailability of two semantic foundations of comparative philosophy: one is effective cross-cultural communication between two cultural-languages communities, the other the semantic comparability of two cultural-languages. Based on my presuppositional interpretation of the thesis of incommensurability as cross-(scientific) language communication breakdown, effective cross-language communication between Chinese and Western cultural-language communities is inevitably partial due to substantially distinct cultural schemes embedded within both cultural traditions. More precisely, there are two special forms of incommensurability faced by those comparative philosophers, namely, the failure of mutual understanding and effective communication breakdown. Consequently, comparative philosophy between two radically distinct cultural-language communities is severely compromised. Rational comparison between them is problematic, difficult, and even seems in some measure unattainable.

Does this mean that rational comparison between the two radically distinct cultural-languages is impossible? In contrast with semantic comparison between commensurable languages, I have argued elsewhere that the dominant semantic relation between two incommensurable cultural-languages is the truth-value functional. When the cultural schemes of two competing cultural-languages are incompatible, the two languages are incommensurable. Nevertheless, it is exactly this incompatibility between the cultural-schemes of two cultural- languages that sets a foundation for presuppositional comparison needed for comparative philosophy.

Kuhnian Turn in Scientific Rationality

Cho In-Rae
Philosophy, Seoul National University, Seoul, SOUTH KOREA

Kuhn was critical about the once-mainstream formal approaches to theory evaluation, particularly logical empiricists' probabilistic confirmation theories and Popper's falsification theory. Alternatively, he offered a procedure of theory choice based on scientific values, and took one of its main merits to be that it allows for rational disagreement among scientists in theory choice. However, his values-based mechanism for theory choice tends to imply that any theory choice made by scientists be taken to be rational. I call this radical implication the problem of excessive methodological liberalism. Another difficulty with Kuhn's values-based mechanism of theory choice is that it seems to have a hard time in answering the question of how scientists can and do converge in their theory choice throughout scientific revolutions. I call this difficulty the consensus problem. My diagnosis is that the lack of methodological constraints on individual scientists' practicing scientific values is mainly repsonsible for both problems.

CONTRIBUTED PAPERS / B1.2 METHODOLOGY

To deal with these problems, I argue for a revisionary reading of Kuhn's values-based mechanism for theory choice. In my revisionary reading, I suggest that the strategies of methodological divergence or convergence and their associated tactics of adjusting the weightings of scientific values need to be adopted in due time as methodogical constraints, and those strategies and tactics will contribute to resolving the problem of excessive methodological liberalism and the consensus problem, while maintaining the advantage of Kuhn's original view in handling the problem of producing rational disagreement in theory choice. Further I lay out two important implications such revisionary reading seems to have on the nature of scientific rationality and in turn of scientific methodology. One is that the rationality of scientific community in theory choice is prior to that of individual scientists. And the other is that what I call a soft methodology results from my revisionary reading.

Progress across revolutionary change in science

Collier John
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Since the demise of logical empiricism in the 1970s, it has remained unclear what is preserved through major theoretical changes in science, and whether there is anything like scientific progress. There are two arguments for this conclusion. One is the pessimistic induction that all theories in the past have been found to be false, so it is likely that our current theories are also false. There other argument is that there is no possibility of comparison of theoretical content across major conceptual changes. I have previously argued that the second argument can be resolved by recognizing that the comparison of theoretical content is a pragmatic issue that can be resolved by pragmatic means. Here I will argue, by analogy to my arguments for progress in biological evolution, that conceptual progress is possible in terms of an increase of information about the world, rather than as an increase in truth content. I will show that this fits happily with the pragmatic approach to conceptual comparison.

Why the Function of Concepts Matters

Cheon Hyundeuk
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To understand scientific practices of developing and working with concepts, it is required to take the function of concepts seriously. The function of a concept plays descriptive, normative, and explanatory roles: first, it tells us what scientists aim to achieve with the concept; second, it provides the norm against which the uses of the concept are evaluated; third, it helps to explain the rationality of conceptual changes and variations. Despite its significance, little philosophical attention has been given to the function of concepts. One notable exception is Ingo Brigandt (2010), who suggests incorporating the epistemic goal pursued with the concept's use as one of semantic properties of concepts along with the concept's reference and its inferential role. It is argued, however, that his suggestion has two limitations. First, it is hardly justified to regard the epistemic goals associated with the concepts as a "semantic" property (Misplacement Problem). Second, he fails to provide the independent reason for the suggestions, depending exclusively on the ability to account for the rationality of semantic change (Independence Problem). To remedy the predicaments, I suggest taking concepts as cognitive entities rather as merely linguistic ones. By doing so, we find an independent, empirical evidence showing that functional information affects on our cognitive processes. Such consideration casts a new light on the Misplacement Problem. It is claimed that the function of concepts is not a semantic property but a type of meta-information regulating a body of concept-constitutive information.

B1.3 METHODOLOGY

Wednesday, August 5 • 11:00–13:00
Main Building, Room 13

Philosophy and Methodology of Change: Systems of Change as an Object of General Change Methodology

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By present time, a large number of different types of abstract systems (e.g., systems of regulation, autopoietic systems, dissipative systems, self-organizing systems etc.) have been developed within the framework of the systems approach and systems philosophy. Each of these types of systems, on the one hand, is the object of the appropriate methodology, and, on the other hand, serves as a conceptual framework to describe and study a certain level or aspect of organisation of some ontological phenomena. However, the further development of the concept of "a system of complementary changes", introduced by Henri Bergson, is still important. Because none of the known types of systems is focused specifically on the description of such ontological phenomenon as the continual variability of the real. The resulting lack of appropriate general methodological tools leads to a number of significant problems in the development of many areas of modern knowledge, design and production. This paper reviews methodological issues surrounding the conceptualization of non-independent and intertwined moments of conservation and change; examines a methodological approach, based on the concept of systems of change – systems oriented to description and/or implementation of the processes of conservation and change; provides definitions of appropriate basic processes, basic principles and basic analytic units; discusses the advantages and disadvantages of proposed approach; provides comparisons to other similar approaches and examples of analysis performed using the systems of change methodology.

Scientific Thought Experiments and their Context: Einstein's Magnet-Conducto

Potters Jan
Philosophy and Moral Sciences, Ghent University, Ghent, BELGIUM

The contemporary debate on scientific thought experiments is characterised by an epistemological focus: what needs explanation is how thought experiments, as a form of a priori reasoning, can provide us with new knowledge of reality. I will start by showing how this epistemological claim contains three sub-claims: (i) thought experiments bring about epistemic effects, (ii) they do this via epistemological mechanisms, and (iii) they have this effect on rational agents. Via a discussion of Albert Einstein's magnet-conductor thought experiment I will put this epistemological perspective to the test. By contrasting my analysis of the thought experiment with John Norton's epistemological analysis, I will show how this epistemological focus is both too strong and too narrow. The epistemological focus is too strong in the sense that the thought experiment does not bring about new knowledge of reality: it rather suggests a theoretical hypothesis, the electric field transformation, to make electrodynamics conform to the special theory of relativity. The epistemological focus is too narrow in the sense that the thought experiment has effects on other levels besides the rational agent: I will distinguish (intended) effects on the level of the scientific theory, the individual scientist and the level of the scientific community. These results will then allow me to formulate an alternative perspective on scientific thought experiments that takes into account the historical context in which they function.

Comprehensive Epistemology and the Philosophy of Science

Ray Nicholas
Philosophy, University of Waterloo, Guelph, CANADA

What is the relationship between our commonsense view of the world and our scientific view of the world? The logical empiricists provided one prominent answer to this question. They maintained that normal discourse and scientific discourse were factual in nature—based on a theory of verification or confirmation that found its roots in normal observation of the world, capable of being applied as an epistemological account of what separates science from non-science. All genuine knowledge rest on empirical testability (and, eventually, empirical observation). The boundary between commonsense and science is merely illusory, based on a misconception that there is something more to the "logic of science" than an extension of normal empirical methods. Whether

we are making ordinary empirical judgments, or claims of a more sophisticated sort in physics, we are to be held to the same demands imposed by the empiricist account of warrant. Call this "comprehensive empiricism". While the logical empiricists' unified account of all factual discourse was rightly criticized for its reductionism, and their logic of confirmation problematic for several technical reasons, their commitment to comprehensivism has received too little attention in the recent literature. I argue that this commitment is attractive in its own right, and divorceable from other logical empiricist theses regarding reductionism, physicalism, verificationism, and anti-metaphysicalism. My principal aim in this presentation will be to establish the cleavage between comprehensive empiricism and logical empiricism. I will argue that comprehensive empiricism is a promising research project, amalgamating some recent technical developments in general epistemology and the philosophy of science. In particular, I will focus on Anil Gupta's new empiricism in general epistemology, exploring the possibility that some variant of this empiricism (based on the logic of interdependence) might be fruitfully extended to recalcitrant problems in the philosophy of science

Inconsistency Handling in the Sciences: Where and How Do We Need Paraconsistency?

Meheus Joke
Centre for Logic and Philosophy of Science, Ghent University, Ghent, BELGIUM

Ever since the pioneering papers by John Norton, Joel Smith, and Bryson Brown in the late eighties, inconsistency in science received considerable attention from philosophers of science (as witnessed, for instance, by Peter Vickers' recent book "Understanding Inconsistent Science"). This led, on the one hand, to downplaying the importance of inconsistent theories and, on the other hand, to the view that inconsistency handling in the sciences, if needed at all, is a matter of content, not of form. Following Norton and Smith, most philosophers of science now seem to agree that scientists, when faced with inconsistencies, avoid "logical anarchy" by a "content-driven control" and not by a "logic-driven control". This is in striking contrast to the view of the "friends of paraconsistency". For decades, they have been claiming that the history of science shows numerous examples of inconsistent theories and that handling such theories requires a suitable non-classical logic. Should they now admit that, in their enthusiasm for promoting their tools, they may have been overrating the importance of inconsistencies in the sciences? Or, could it be that

philosophers of science are missing something? In the present talk, I shall first investigate into the possible reasons for the deep divide between philosophers of science and paraconsistent logicians. On the one hand, I shall argue (by referring to examples from the sciences) that inconsistencies in the sciences occur more frequently than Vickers and others admit, but that

one has to look in the right places. On the other hand, I shall argue that paraconsistent logicians have not always been using the right kind of arguments to promote their tools. A second aim is to discuss the distinction between content-driven and logic-driven approaches and argue that some content-driven approaches presuppose a logic-driven control.

B1.4 METHODOLOGY

Wednesday, August 5 • 11:00–13:00
Main Building, Room 3

Journal Peer Review, Biases, and the Objectivity of Research

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The virtues and weaknesses of peer review have been widely examined in the literature (e.g., Cole 1992; Lamont 2009). However, philosophical discussions on the topic are scarce. This is puzzling as in many social epistemological theories (e.g., Longino 1990), peer review is mentioned as one of the central mechanisms for maintaining the critical scrutiny of expressed views and, thus, the objectivity of research. In this paper, I shall discuss journal peer review as a mechanism for differentiating reliable scientific work from inadequate projects and improving the quality of published work. I approach the topic by examining different biasing factors that have an impact on the outcome of peer review processes. I will argue that achieving the aims of peer review can be hampered not only by individual-level biases but also by institution-level mechanisms. Thus, I show how examinations of peer review process highlight the ways in which social factors are essential to maintaining the quality of science, and how the social context in which peer review takes place can either contribute to or work against controlling the biases that have an impact on review outcomes.

The Epistemic Role of Standards in Science

Vega-Encabo Jesús
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Standards play a major role in science. Examples are many, from standards of measurement to the oncomouse. It has been claimed that the proper object of scientific study is not nature as such, but a "standardized and controllable nature". Science promotes ways of framing experience under normalized and standardized conditions of producing phenomena. But until now few have been the efforts to address the epistemic role of standards in scientific contexts. I understand standards as epistemic tools, in the sense that, on one hand, standardization processes are dependent on knowledge and learning and, on the other hand, standards' main function is to organize the production of knowledge in cooperative settings. It is this second dimension that will be considered here. I will argue that standards should be taken as part of a general theory of epistemic reliance on other people and artifacts. I emphasize three features in accounting for the epistemic role of standards. First, they are tools that help solve coordination problems; the normative dimension of standards is not independent of how they allow to coordinate research activities and provide a setting for epistemic agents to rely on other agents and on the deliverances of instruments and artifacts. Second, standards are keys in contexts where control systems depend on trust relations; so in science, where they articulate a context where certain conditions for trust are preserved. Third, they contribute to strengthen the level of reliability of cognitive distributed processes. Standards act as operators that transform knowledgeseeking contexts by securing the obtaining of relevant epistemic properties (like truth, empirical accuracy or others). Standards work as reference points which any competent epistemic agent can appeal to in order to organize the experience of the world in such a way that a certain level of reliable performance is collectively secured.

How trading zones may help solving communication problems in the sciences

Mendes João
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Since its dawn, modern science has been undergoing an increasing specialization and sophistication. No philosophical project for the unification of the sciences was ever effective enough in stopping or even slowing down that phenomenon. As result we have now a very fragmented scientific disciplinary landscape and perhaps worse we have deep problems of communication within particular sciences, between several sciences, between sciences and other non-scientific domains, namely the humanities, and between sciences and general society. Communication problems are especially worrying because they not only undermine the cohesion of scientific disciplines, as also impede or retard the integration of scientific knowledge, and ultimately its progress, and destabilize the processes of knowledge transmission and sharing.

The main purposes of my presentation will be, then: (a) to examine the epistemic status of the so-called "trading zones" (a concept and expression crafted by north-American historian and philosopher of science Peter Galison in his 1997 essay Image and Logic, further explored in a sort of taxonomy of possible kinds of expert collaboration by Harry Collins, Robert Evans, and Michael Gorman in chapter 1 ("Trading zones and interactional expertise") of the 2010 collective book (ed. M. Gorman) Trading zones and interactional expertise; (b) to analyze their creation procedures; (c) and to critically understand how they can be put to work as an efficacious tool to help solving the eferred communication problems that are tormenting contemporary science.

Considering the Quantum Hypothesis in the Context of Pursuit

Kao Molly
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In recent years, there has been a surge in the philosophical literature on the "context of pursuit," stemming from recognition of the fact that scientists do not simply accept or reject scientific theories, but must decide whether or not to pursue them. I provide a new case study on pursuit, focusing on the emergence of a hypothesis of quantized energy in the years 1900 to 1913.

Max Planck first introduced the idea of discrete "energy elements" in 1900 in response to experiments on blackbody radiation that could not be accounted for in classical terms. This was followed by other applications of the idea of quantized amounts of energy by scientists in diverse contexts, such as Einstein's work on light quanta and specific heats, and Bohr's old quantum theory of the atom. One interesting issue about these investigations was that scientists disagreed, sometimes strongly, about the physical basis of this postulate, as well as how to understand its significance for classical physics. I argue that despite these disagreements, there was something we can call "the quantum hypothesis," which accurately captures an important element of each of the uses of the idea of quantized energy. Research into this quantum hypothesis eventually led to the enormously successful theory of quantum mechanics.

Much of the work on the context of pursuit focuses on the analysis of theories that are at least somewhat articulated. On the basis of this case study, I argue that the pursuit of an empirically adequate theory may pass through a stage where even a rudimentary theory is not available. I thus contribute to our understanding of theory pursuit by suggesting that we must sometimes consider promising new and problematic hypotheses, and not just theories that are nominally coherent frameworks.

B1.5 METHODOLOGY

Thursday, August 6 • 14:30–16:30
Main Building, Room 13

Re-discovery of the Nature and Logic of Scientific Discovery

Lei Liang
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Analyzing scientific discovery semantically, or researching the activities of scientific discovery themselves historically, we will find that, despite the social, historical, and psychological properties, scientific discovery is actually a logical process of generating, choosing, revising receiving and interpreting new hypothesis, the logical mechanism is just abduction advocated by Charles S. Peirce and Norwood R. Hanson Hanson etc. Moreover, it is the new achievement of modern cognitive science that makes it clear that background theories and knowledge play an important role in the course of hypothesis generation and selection, and promotes innovation of the forms of abduction, thus, the questions why and how abduction can become the logical mechanism of scientific discovery is answered satisfactorily.

Forced Reinterpretation, Incongruity-Resolution and Scientific Discovery

De Mey Tim
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In Patterns of Discovery, Hanson suggested that abduction is the basic problem-solving process involved in scientific discovery. In a completely different field, i.e., the cognitive linguistics of humor, scientists like Attardo and Raskin, have claimed that getting jokes basically involves "forced reinterpretation of incongruity-resolution" and they have identified numerous, associated "logical mechanisms", all of which can be considered to be specific cases of abduction. In this paper, I put more structure on these "logical mechanisms", grouping them together in five basic categories. Subsequently, I argue on the basis of various examples, that these five basic "logical mechanisms" do indeed capture a substantial part of "the logic of scientific discovery". Finally, I suggest that on a reasonable extension of the notions at issue, one can even suggest that all scientific discoveries involve such "forced reinterpretation of incongruity-resolution".

Natural kinds and automated scientific discovery

Jantzen Benjamin
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I present an algorithm for automated scientific discovery designed to operationalize and, in effect, test Jantzen's (2014) recent theory of natural kinds. Jantzen views the problem of natural kinds as a pair of related epistemic puzzles: (i) what distinguishes those classes of physical system suitable for scientific generalization from those that are not?; and (ii) how is it that we recognize the kinds that are likely to be appropriate for generalization? With respect to the first question, he suggests that members of the same natural kind are collections of causally connected variables that are identically indifferent to a set of interventions he calls 'dynamical symmetries'. More specifically, a dynamical symmetry with respect to a variable, V, is an active transformation of a system with a special property: it makes no difference whether one applies the symmetry transformation and then intervenes on V, or intervenes on V and then applies the symmetry transformation since the final state is the same either way. In classical mechanics, examples of dynamical symmetries with respect to time include rigid translations and rotations. Symmetry transformations compose -- a symmetry followed by another is itself a symmetry transformation. A set of dynamical symmetries along with a particular pattern of behavior under composition constitutes what Jantzen calls a 'symmetry structure'. A set of causal systems sharing a common symmetry structure is a natural kind. As Jantzen points out, if symmetry structures characterize natural kinds, then a plausible answer to question (ii) is that we efficiently identify suitable scientific kinds by spotting symmetry structures. The algorithm described here is an explicit method for detecting symmetry structures. Preliminary results from the application of this algorithm to real-world physical systems are also presented, and provide support for Jantzen's approach.

Jantzen, Benjamin C. 2014. "Projection, Symmetry, and Natural Kinds." Synthese, 1–30. doi:10.1007/s11229- 014-0637-5.

B1.6 METHODOLOGY

Thursday, August 6 • 17:00–19:00
Main Building, Room 13

An Interactive Criterion for Realism

Ruttkamp-Bloem Emma
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It is argued that whether realism is warranted with regards to particular theories depends on the kind and quality of evidence available. Thus one is warranted a realist stance towards those aspects of scientific investigations that demonstrate actual science-world interaction. This interaction is visible, inter alia, in the revisions science affects in its theories based on feedback from the experimental side of science, and in revisions in the experimental design side to accommodate theory revision. Such revision is measured in terms of the 'evolutionary progressiveness' of theories (this notion will be unpacked carefully). It is argued that realist arguments should not turn on how closely science represents reality, but rather on how well science and reality engage each other. If it is true that the metaphysical import of successful theories consists in their giving correct descriptions of the structure of the world, the epistemological import of successful theories consists in their being the crystallisation of a process or method of continuous revision and sifting claims. A theory that can absorb revision (thus which is evolutionary progressive) is (obviously) much stronger than one that is true in all possible worlds, because an evolutionary progressive theory contains much more knowledge of the system it describes in the sense that it reflects knowledge of what should be left out of descriptions of the system (based on current evidence), while a theory that is always true does not reflect such knowledge of the system. A new criterion for realism is thus suggested in terms of the quality of 'evolutionary progressive' interaction between the experimental and theoretical levels of science. Truth is assembled as science progresses through revisions and corroborations and the content of what is assembled is captured or revealed by relations of reference supervening on the evolutionary progressiveness of theories.

Theory-Progressivism: Between Realism and Anti-Realism

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I characterise a novel epistemological attitude towards fundamental physics: theory-progressivism. Theory- progressivism falls between realism and anti-realism as standardly characterised. On the one hand, it resembles scientific realism in its spirit by virtue of involving a commitment to a certain kind of distinctly theoretical progress (as opposed to merely instrumental or empirical progress): theories in e.g. fundamental particle physics latch better and better onto unobservable reality in ways that are responsible for those theories' empirical progress. This notion of 'latching onto reality', as I will characterise it, satisfies the realist intuition that the empirical success of science would be a 'miracle' if science was not tracking unobservable reality. On the other hand, theory-progressivism gives up certain commonly held aspects of scientific realism, such as the notion that theoretical progress in fundamental physics is either (i) a matter of increasing knowledge of the unobservable reality, or (ii) theories' increasing verisimilitude. But despite giving up on realism in this sense, theory-progressivism exhibits a minimal realist attitude that distinguishes it from neo-instrumentalism (Stanford) or constructive empiricism (van Fraassen). It also recommends a distinctive commitment to current theories' correspondence to future theories. I delineate theory-progressivism in terms of a particular conception of theoretical progress, which I in turn characterise in relation to two prominent accounts of cognitive/epistemic progress: the 'epistemic conception' (Bird), and the verisimilitude conception (e.g. Niiniluoto). Both of these accounts are too narrow to fully capture the theoretical progress that radically false theories can make. I appeal to recent work on the correspondence between Newtonian gravity and General Relativity to illustrate all this, the general thought being that if we are open to the possibility of equally radical revolutions in our future physics, the realists' epistemic attitude to our current theories is best captured by theory-progressivism.

Why Psillos' Purportedly Scientific Argument for Scientific Realism Fails

Gubelmann Reto
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This paper examines the so-called explanationist defense of scientific realism (EDR), as proposed by Stathis Psillos. Psillos' EDR has two parts, both of which have the form of inference to the best explanation, or abduction. The first part focuses on specific scientific theories that are successful in predicting novel empirical phenomena. In the tradition of Hilary Putnam's no-miracle argument, it is abductively inferred that these theories must be approximately true. In the second part, it is argued that the repeated success of science to produce empirically successful theories is itself in need of explanation, the best explanation being that the method by which these theories are obtained, namely abduction, is typically truth-conducive. Therefore, abduction is typically truth-conducive. Psillos holds that EDR is a scientific argument, and therefore satisfies the requirements of methodological naturalism, because abduction is the central scientific method.

My critique of EDR proceeds in three steps. In a first step, the charge of vicious circularity, the most popular critique of the argument, is examined. It will be shown that it can be put forward only by paying a dialectic price, namely by acknowledging that the method used by the argument is indeed the scientific method, and that proponents of the critique are committed to an untenable global skepticism with regard to abductive reasoning. In a second step, it is argued that the same property that immunizes EDR against charges of vicious circularity, to wit its using a form of inference that is omnipresent and extremely multi-faceted, is equally responsible for its ultimate failure: without further specifying the conception of "best" used in the abduction, it is simply wrong that abduction is typically truth-conducive. In a third step, it is shown how this presents Psillos with a dilemma: he must abandon either methodological naturalism or scientific realism.

Explanation by idealized theories

Niiniluoto Ilkka
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Idealized scientific theories tell how natural and social systems behave under counterfactual conditions, so that their descriptions of actual situations are known to be false. Therefore, by Hempel's classical standards, the use of such theories as covering laws in explanations of empirical facts and regularities is problematic in two ways: they don't satisfy the condition that the explanans is true, and they may fail to entail the empirical explanandum. An attempt to deal with the latter problem was proposed by Hempel and Popper with their notion of approximate explanation. A more systematic perspective on idealized explanations was developed in the method of idealization and concretization by the Poznan school (Nowak, Krajewski) in the 1970s: idealized theories can provide explanations if their hidden ideal assumptions are first made explicit as antecedents of idealizational laws and then these assumptions are eliminated or relaxed by modifying the consequent. In this way the gap between an idealized theory T and empirical data E can be narrowed: to explain E by T one has to concretize T into a new theory T' and then derive E from T'. Nowak formulated idealizational laws as material conditionals, so that they are trivially true. In this paper, it is suggested that idealizational laws should be treated as counterfactual conditionals, so that they can be true or truthlike, and the concretizations of such laws may increase their degree of truthlikeness. Further, by replacing Hempel's truth requirement with the condition that an explanatory theory is truthlike one can distinguish several important types of approximate, corrective, and contrastive explanations by idealized theories. In particular, one can study whether explanatory theories may contain non-Galilean idealizations which cannot be concretized or de-idealized, or whether explanation presupposes successful representation. The conclusions have important consequences to the debates about scientific realism and anti-realism.

B1.7 METHODOLOGY

Friday, August 7 • 14:30–16:30
Main Building, Room 13

The No Alternative Argument and the Problem of Establishing Non-empirical Evidence

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In a recent paper (forthcoming in BJPS) Dawid, Hartmann and Sprenger have proven within a Bayesian framework the following rough statement called the no-alternative argument (NAA): the fact of knowing that there is no alternative theory to one's theory, at a given time and despite considerable effort, confirms the theory. The fact that there are no alternatives to one's theory is considered as non-empirical evidence. The aim of this paper is to analyse how one can establish non-empirical evidence of this kind. I consider two problems to establish non-empirical evidence. The first problem arises from the fact that one has to be able to individuate theories to claim that there are no alternatives. Dawid et al. want to leave this problem to the scientist. This turns out to be unsatisfactory, as many examples show. I will propose an alternative individuation procedure which is pragmatically problem-oriented which in turn, however, relates this problem to the second problem. A NAA is always relative to a set of problems that need to be solved. The determination of this problem set is highly non-trivial, as e.g. in theories of quantum gravity, where it depends on the research programm within which the scientist works. There are two possible conclusions one can draw for the NAA from this: first, since the set of problems is research program dependent, the NAA provides only an explanation of scientific practice, namely it explains why scientists work on what they work on. Second, if the NAA is suppose to confirm the theory itself rather than the practice of the scientist, further justification for the specific problem set need to be given. I argue that, Dawid's meta-inductive arguments can in principle provide these but are insuffcient in the specific case of theories of quantum gravity where they are needed most crucially.

Induction and ceteris paribus clause

Grobler Adam
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Well-known paradoxes of confirmation like Raven and Transitivity put the validity of inductive reasoning of any kind into question. On the other hand, the proponents of hypothetical-deductive or abductive method make some use of inductivist motifs. If Popper is careful enough to distinguish between corroboration and confirmation, Lakatos quite straightforwardly maintains that a falsification of one hypothesis is a confirmation of another one. Next, Harman's reintroduction of abductivism long after Peirce's invention is, in fact, an attempt at grounding the inductive method in the principle of inference to the best explanation. In the paper I will claim that paradoxes of confirmation raise because of excessively formal analysis of scientific reasoning. In discussing the paradoxes in question it is neglected that scientific hypotheses inevitably assume ceteris paribus clause. Taking ceteris paribus clause into account enables one to distinguish between valid and invalid transferring a confirmation of an hypothesis to its logical consequences. This solves the paradoxes. Despite the age of the problem under consideration, the present proposal sheds a new light on the nature of inductive reasoning, its place in the scientific method, and the methodological and epistemological status of ceteris paribus clause.

Unconceived alternatives and expected unification: a limitation of Stanford's "new induction"

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In this paper I adopt a standard strategy against the "new induction" of Kyle Stanford's (2006). I show that in the case of present or future scientific theories, Stanford's "new induction" (NI) is less likely to apply than for cases typically taken from the history of science. I do not reject NI in general and I do not argue with Stanford on the string of examples in which it works (chapters 4-8 in his 2006 book). I question its power of generalization from past cases to current of future occurrences. My argument attacks the assumption that present theories would be eventually replaced by unconceived (at the present) alternatives, in the same way and with the same power as some theories in the past were replaced by unconceived alternatives. The cases in which we should be less suspicious that an unconceived alternative might eventually replace a current theory is when the current theory is unificatory enough.

The general question addressed here is whether theoretical virtues (non-empirical virtues) can be used to block Stanford's antirealism strategy. But for each specific case I show that unificatory power does reduce the chances of an unconceived alternative. There are cases in which we have serious suspicions that an unconceived alternative I show that although the conclusion is warranted in many cases, for a large class of theories, present or future we have reasons to believe that our inability of conceiving alternatives to T is lessened. We have in other words difference mechanisms to "parse" the logical space of serious and genuine alternatives to a current theory T. I argue that is some specific conditions, the inductive reasoning in NI is weaker than it seems. In this paper I focus on unification and role it plays in reducing the logical space of possible alternatives. More unificatory theories admit serious alternatives, as any other theory, but according to my argument the possibility that in the future such alternative will undeniably replace completely T are much slimmer. As a concrete case of unification and the pruning of alternative I focus on a episode in the history of the Standard Model.

The New Riddle of Induction and the New Riddle of Deduction

Yehezkel Gal
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In his "New Riddle of Induction" Nelson Goodman raises the difficulty of defining the difference between valid and invalid inductive inferences. Goodman shows us that it is possible to construct allegedly unprojectible predicates, which would lead to absurd and unacceptable conclusions if used in inductive inferences. Although there are those who challenge this conclusion, they are also many who believe that Goodman's riddle amounts to a proof of the impossibility of a purely syntactical theory of confirmation.

The importance of the question of whether inductive validity can be defined syntactically is obvious. The alleged impossibility of a purely syntactical theory of inductive validity constitutes a fundamental difference between induction and deduction, and casts a shadow on the rationality of induction.

In my lecture I shall employ the analogy between deduction and induction to support my claim that the new riddle of induction does not prove that formal criteria for inductive validity are impossible, by formulating the "new riddle of deduction," in analogy to the new riddle of induction. If the new riddle of induction proves that inductive validity cannot be defined syntactically, the new riddle of deduction proves that deductive validity cannot be defined syntactically either. However, it is generally agreed that deductive validity can be defined syntactically. Thus the "new riddle of deduction" sheds light on the "new riddle of induction," and shows that it does not prove the impossibility of purely syntactic laws of induction. I shall further rely on the analogy between induction and deduction in order to explain why some predicates, such as "grue" are unprojectible.

B1.8 METHODOLOGY

Friday, August 7 • 17:00–19:00
Main Building, Room 13

Truth re-nomination and the Lotka-Volterra-model

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Idealizations in scientific models are strategic misrepresentations of a model's target system: they are known to be false, yet many of them are retained not despite their falseness but because they can support a model's representational aims. This raises a conundrum: How is it possible for us to interpret a model realistically in spite of such strategic misrepresentations? One account proposes that idealizations need to undergo a process of "truth- renomination" (this has been developed by Uskali Mäki in a series of papers). In some instances, truth re-nomination makes it possible to interpret idealizations realistically. For example, in modeling movement on an inclined plane it is false to assume that there is no friction. Yet if we paraphrase the assumption as "friction is negligible", it is transformed into a potentially true claim. Similarly, a paraphrase may restrict a problematic assumption's applicability to a range where it is actually true. However, other types of truth re- nomination are not easily squared with a realistic interpretation, and these indicate that a model is in need of refinement. Such idealizations involve "meta-claims": they may be introduced as early steps that will require reworking later on; they may make the model more tractable; or they may serve pedagogical purposes. Thus, truth re-nomination offers a framework for classifying idealizations and for assessing their claim to realism. However, careful case studies are needed to determine whether the framework can illuminate substantial idealizations in actual scientific models. Two questions are pressing. First, does the epistemic practice of scientists mirror the above categories – or is the framework a mere philosophical gloss on actual science? Second, how does the classification of idealizations change over time? In particular, one would expect a shift from problematic "meta-claim" idealizations to "paraphrase" idealizations, as scientists develop a model and try to apply it to real-world systems. Is such a shift discernible? We will study these and related questions using the Lotka-Volterra predator- prey model. Beginning with the publications by Vito Volterra and Umberto d'Ancona in the 1920s, and continuing on to the further development of the model, we will offer a sketch of the medium-term dynamics of idealizations in the predator-prey model.

Philosophical Models - Their Structure and Function

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There are various methods of analytic philosophizing. My aim is to outline a general structure of philosophical models and argue for their considerable role in discovering and testing philosophical theories. Firstly, I discuss a general structure of philosophical modeling. I propose to treat philosophical models as abstract (fictional) entities with various epistemic and ontological statuses. I take them to be the products of well-developed thought experiments representing some (logically or nomologically) possible or counterfactual situations. (A useful theoretical framework for thinking about thought experiments is found in R. Cooper, "Thought Experiments", Metaphilosophy 36, 2005, No. 3, pp. 328-347.) I argue that, unlike many (kinds of) scientific models (cf., e.g., M. Weisberg, Simulation and Similarity, Oxford University Press 2013), philosophical models do not primarily aim at representing some actual phenomena (i.e., target systems). Rather they point out to those possible aspects of entities which have not yet been considered or reflected relative to an actual situation (or target system). Secondly, by analyzing several examples of philosophical models (e.g., Strawson's hypothetical case of purely auditory experience; Goldman's fake barns), I distinguish two of their fundamental functions in relation to philosophical theories: i) the constructive function (e.g., to establish that such-and-such is possible); and ii) the destructive function (e.g., to falsify that such-and-such is necessary or that such-and- such is possible).

Manipulationist Account and Unificationist Model

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Liu Chuang
Department of Philosophy, Shanxi University & University of Florida, Gainesville, USA

In this paper we provide a critical discussion of James Woodward's manipulationist account, which has become one of the most promising accounts in the recent decade on scientific explanation. Woodward suggests (1) Explanations involve the counterfactual dependence rather than nomic subsumption. (2)

Explanatory generalizations describe the invariant relations between explanans variables and explanandum variables under some range of interventions on the explanans. (3) The requirement of invariance, which admits of degrees, is very different from the traditional demand that explanatory generalizations must be laws.

We criticize Woodward in the following four aspects. Firstly, his preference of invariance put too strong a restriction on the concept of laws. If we take the paradigmatic or pragmatic approach to laws of nature, there should be no significant difference between invariance and laws, especially if laws are regarded as ceteris paribus laws. Secondly, we can add a holistic way of thinking to Woodward's modularity of causal relationship. Thirdly, scientists in special sciences seldom achieve manipulation or intervention, therefore it would be implausible to demand for the invariant relations. Finally, we argue that the manipulationist account should be regarded as a complement or improvement, especially in causal explanations, rather than a replacement, of lawful explanation account.

Our paper suggests a peaceful coexistence of lawful explanation and the manipulationist account, especially within the unificationist model. The lawful account is helpful for us to "Think Global", while the manipulationist account is good to "Act Local".

Keywords: scientific explanation, manipulationist account, unificationist model, invariance

Scientific Modeling and Fictionalism

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Synopsis: This paper mounts an objection to the new fictionalism on models in science (or in general) that is based on a fundamentally different conception of how the reference (or denotation) relation works in modeling. New fictionalism contends that the correct way to view models from an ontological point of view is to view them as fictional entities. Scientists in the practice of modeling reality create with their power of imagination a fictional world of abstract entities; and it is through the study of these entities, such as Rutherford's model of hydrogen atom or the molecular model of DNA, scientists gain knowledge about the real systems that the models represent. In addition, it is said that even though this new fictionalism appears to be against realism, it is in fact compatible with it.

In objecting to this view, we first argue that most scientific models (with the exception of a few more exotic kinds) are not to be seen as imaginary systems but rather as assemblages of abstract or concrete/physical elements (basic or simpler parts or modules for jobs of modeling), and when these assemblages are given referring terms (names or labels or even descriptive phrases) that connect them to the corresponding components of the target systems, the elements and their relational structures in the models show what the target systems are like in the relevant aspects. This combination of the symbolic and the modelistic elements and the division of labor of referring and showing is a typical, if not universal, feature of scientific modeling. It captures the most common types of modeling jobs in the practice of science. (The exceptions are briefly discussed in a footnote, but the lack of space prevents me from treating it properly. It is thoroughly dealt with elsewhere.)

Therefore, there is no need for a fictionalist approach to modeling and my account is clearly compatible with realism. It is also compatible with a truly fictional account of modeling; but it is an anti-realist fictionalist account for representing the unobservable entities. We discuss an interpretation by Rosen on van Fraassen's constructive empiricism, which argues that CE is best understood as a fictional stance on the unobservable. We explore this option in the backdrop of our objection to the new fictionalism, and we defend van Fraassen on one particular criticism of Rosen, which threatens to undo van Fraassen's CE. The upshot of this defense is that there are abstract entities that make a difference to empirical adequacy if treated as real and there are abstract entities that do not. One can be a Plationist/realism about the latter sort of entities and still be a good constructive empiricist who embraces fictionalism.

B1.9 METHODOLOGY

Saturday, August 8 • 13:30–15:30
Main Building, Room 6

A Little Less Representation, A Little More Action Possibilities: Taking the Artefactual View of Scientific Models Seriously

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Recent contributions to the philosophical literature on modeling for the most part fall within a representational view of models. Whether explaining representation in updated accounts of isomorphism (van Fraassen 2008) and similarity (Giere 2004, 2006, 2010), or instead adopting novel inferential (Suarez 2003, 2004), interpretational (Contessa 2007), or semiotic (Knuuttila 2010) perspectives, these accounts generally assume that the model-target relationship is one of representation: we understand a target by examining a model because models represent their targets. Despite its popularity, however, the representational view is faced with

many challenges, a central one being that of explaining the widespread use of "known falsehoods" or intentional divergences between model and target, such as abstractions and idealizations. A powerful but still widely neglected alternative to the representational view is the artefactual view of models. Here I review Knuuttila's (2011) articulation of the artefactual view and criticize it on the grounds that it still maintains representations in the picture, thus not providing a genuine alternative to the representational view of models. In the alternative I propose, the model-target relationship depends fundamentally on what we might call the "presentational force" of a model—in contrast with the "representational force" in the representational view (cf. Suarez 2004, 2010). I articulate this notion of presentational force in terms of the affordances or action possibilities of models and the scaffolding role that models play in understanding. I examine a case of modeling group thermoregulation and energy conservation, and argue that the artefactual view better captures the explanatory contribution of models, not only circumventing challenges inherent to the representational view of models but also preserving advantages of both dyadic and triadic representational approaches, such as objectivity and interpretative diversity.

Agenda of analysis of models: from Big Data to reality

Zagidullin Zhan
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Often forgotten that the concept of model came from the handicraft of blacksmiths, glassblowers and sculptors. And from there it was in the sphere of scientific reflection, where the presence of models began to be perceived as the quintessence of scientific knowledge. Scientific research utilises models in many places, as instruments in the service of many different needs. As physicist Ludwig Boltzmann wrote in the article "Model" from Encyclopaedia Britannica (1902): "It is perfectly clear that these models of wood, metal and cardboard arereally a continuation and integration of our process of thought". Scientists begun to analyze models in their relation to the object of research and begun to perceive them as an indication of mature theories. In 20th century the concept of model gets into philosophy, where it is converted into a tool of philosophical reflection on the activity of scientists. Impetus it was the article of Norbert Wiener and Arturo Rosenblueth (1945) on the role of models in science. Wiener humorously formulates new ideology analysis of models in science: "the best model for a cat is another, or preferably the same cat... This ideal model can not probably be achieved. Partial models, imperfect as they may be, are the only means developed by science for understanding the universe". Now philosophers use the concept of model for theorizing about the narrowness of scientific thinking and the limits of knowledge.

Today we can talk about third agenda. Philosophy is facing a challenge: it will be necessary to understand the effects the rapid development of information technology, growth interdisciplinary synthesis of sciences and accumulation of massive amounts of scientific knowledge (e.g. projects "Genome" and "Cognitone"). The concept of model should help "to return" from Big Data to objects of reality.

Allocating confirmation with robustness

Lehtinen Aki
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A result is said to be derivationally robust if it can be derived from several sets of assumptions. Evidence is indirect with respect to a given result if the result does not imply the evidence but yet the evidence confirms it. I will show that derivational robustness of a result may increase the degree to which existing pieces of evidence indirectly confirm it. The argument is thus based on combining robustness and indirect confirmation such that the evidential boost from old evidence is shown to bear more heavily on those parts of the models that are also needed for deriving the robust result : old confirmatory evidence may weigh more heavily on the robust result if t is shown to be derivable from the same assumptions as the robust result. By showing that the core is really necessary, derivational robustness may thus increase the weight with which existing evidence indirectly confirms the robust result. I introduce an example from climate modelling in which a model has initially both confirmed and disconfirmed results. Showing the derivational robustness of a result confirms it if the confirmatory power of the existing positive evidence on the initial version of the model can be allocated to the core, and the robust result is shown to depend on the confirmed core rather than on the disconfirmed assumptions. In order to show that the weight with which disconfirming evidence disconfirms the robust result is decreased, one also has to show that the auxiliaries are dispensable with respect to the robust result, and that they are responsible for the disconfirmed result in the initial model. However, whether or not robustness confirms is a context-specific matter. Robustness may also disconfirm.

B1.10 REPRESENTATION

Wednesday, August 5 • 14:30–16:30
Main Building, Room 12

Why is Representation Communal Rather than Private?

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Much work has been done by philosophers of science on the topic of scientific representation. This work has often taken to answering one of two questions. The first asks about the typical uses of representations, identifying common features or perhaps peculiar but instructive features of different types of representations. The second question attempts to give a strong account of the nature of representation, perhaps explaining representation in virtue of structural isomorphism, similarity, or in reference to the inferences made by an agent who is doing the representation. While these are rather interesting questions which deserve attention, I think there is another interesting question which has received less attention: why is representation as it is? In this

presentation, I will take up that question. I will work within a broadly inferential account of representation, drawing an instructive comparison to 'reminiscence.' Like representation, reminiscence is also practical; that is, it is a relationship that holds in virtue of the inferential performances of an agent; additionally, it often (though not always) involves similarity of some sort. Reminiscence is also interestingly private: whether or not any agent is reminded of some object is entirely up to their private performances. The same is not true of representation, which necessarily requires reference to the judgments, associations, and intentions of a particular community. I show this by first explaining why this is true of artistic representation, and then turning to examples of scientific representation. The examples serve to show the importance of the social reference, but also to show that this does not make representation non-inferential. As a closing thought, I link up these thoughts on representation with Wittgenstein's private language argument, indicating that this fact is not incidental, but rather a necessary feature of representation within the practice of scientific inquiry.

The Role of Subjective Models in Proto-Scientific Measurement

Isaac Alistair
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The earliest stages of a measurement practice typically involve the operationalization and objectification of some subjective assessment of the world via an external, publicly accessible measurement device: for instance, the transition from subjective sensations of hot and cold to the use of columns of fluid in thermoscopes for measurement of temperature (Chang, 2004). The refinement of this measurement practice is then guided by parallel developments in theoretical models (van Fraassen, 2008; Tal, 2012). In this project, I consider strategies for ensuring measurement stability when an objective model is unavailable. The examples I consider resist objectification either because they are targeted at inherently subjective quantities (the Scoville scale for spiciness; the Mercalli scale for the intensity of earthquake effects) or because the relationship between observable effects and presumed underlying cause is too convoluted to permit observer-independent operationalization (academic grade assessment; the use of looking-time to measure infant novelty detection). These measurement practices conform to the standard formal account (Krantz, et al., 1971) and appear to exhibit improvements in rigor and stability over time. However, I argue that the standard analysis of such improvements in terms of parallel theoretical developments is unavailable here due to the constitutive role of subjective mental models in these practices. Traditional analyses of the role of mental models in scientific reasoning (e.g. Hesse, 1962) take them to be externalizable for community assessment via (e.g. mathematical) public descriptions. However, the models that guide these measurements cannot be communicated explicitly —this is the sense in which they are subjective. Nevertheless, training and intersubjective comparisons may serve a regulatory role, allowing for improvements in both precision and accuracy of measurements that approximate those which can be achieved through interplay with objective theoretical models. This analysis sheds light on more general questions about the theory-ladenness of data accumulation and scientific progress.

Scientific understanding as guidance of and for cognitive activity

Argott Arturo R.
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Scientific understanding has become a trending topic of interest in the last few years. This is demonstrated by the progressive increase in the number of publications and works of authors with the main research theme as scientific understanding. Unfortunately, a clear delimitation of the possible objects of scientific understanding is still absent. There are two fundamental perspectives to approach the issue: (1) the perspective from which scientific understanding is characterized as the result or product of certain cognitive processes; and (2) the perspective from which scientific understanding is conceived as an ambiguous epistemic practice. In the following article, I argue in favour of this second perspective from an analytical point of view. I propose that scientific understanding is a set of cognitive activities that have been proven successful in achieving one or many of the traditional epistemic goals of science—prediction, explanation and description of phenomena and entities of the world—with the special condition that these cognitive activities must be adaptable to representation in certain specific languages to serve as guides for other agents when performing them. In summary, to scientifically understand a phenomenon (p) implies that one must be able to intelligibly represent the successful cognitive activity (c) of achieving a specific epistemic goal (g) relative to the phenomenon (p) in question.

Is scientific innovation rationally intelligible?

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While applications of the concept of innovation to scientific methods or theories are of recent origin, the concept is becoming increasingly used in studies of scientific growth, claims of discovery, or funding applications. However, it needs to be critically discussed, as the following dilemma shows: (1) Scientific innovations are rationally intelligible. (2) There is no account of rationality that can render such innovations rationally intelligible. Both (1) and (2) have strong reasons in their favor; but (1) and (2) cannot be jointly accepted, at least not without further ado. In my presentation, I shall first make (1) and (2) individually plausible, and then reflect on what options there are to make them compatible with one another. In support of (1) we assume, for instance, that there are ways for understanding how innovations in science can come about. Innovation isn't mysterious. Also, we do not merely causally explain how an innovative theory or method came about; the very description of a theory of method as "innovative" implies a judgment that the innovation is *reasonable* in some sense. As to (2): Paradigmatic accounts of rationality are (a) standard accounts (formal norms of logic, probability and decision theory), or (b) accounts of bounded rationality (heuristic-based norms), or (c) mixed versions of (a) and (b). But all these accounts are made for making judgments either ex post or in familiar territories – precisely not for genuinely novel theories or methods. These are typically developed under conditions of strong uncertainty: there has to be a "leap of faith" on the side of the scientist, or the decider in a funding agency. Hence, existing accounts of rationality fail to make scientific innovation rationally intelligible. In conclusion, I argue that the dilemma is best treated by a deeper historical understanding of paradigmatic theories of rationality.

B1.11 METHODOLOGY

Tuesday, August 4 • 17:00–19:00
Main Building, Room 6

On Science and Humanism

Schwed Menashe
Philosophy, Ashkelon Academic College, Ashkelon, ISRAEL

This talk proposes another answer to the unsolved Popperian question of Demarcation. The thesis is that science is not to be characterized by its theories nor by its research methods and models. Rather, the answer is rooted in the values and norms of Humanism. The common thesis is that the scientific research methods and models guarantee the acceptability of scientific claims. However, there is not one method or model that will stand out such that it will qualify as the characteristic one. Furthermore, none will answer for the unity of science nor will help to understand science as a unique culture. Furthermore, this common thesis does not solve the problem of how these research methods and models were selected as scientific in the first place.

This talk argues for two theses: First that the historical and philosophical roots of science are in politics and ideology, and not in any objective ideal. Furthermore, science is a human invention just like art or literature and not for wholly different reasons. Its invention is deeply tied up with the emergence of democracy in ancient Greece and Humanism in the Enlightenment. Second, that science presupposes and advances concurrently Humanistic values, especially the autonomy of the individual to think and decide in a free and uncoerced manner, and the choice to prefer the way of critical reasoning and skepticism.

Two case studies will serve as illustrations to this talk's thesis. The first case refers to the controversy surrounding the removal of the word "science" from the AAA's long-range plan statement in 2010, and will show why it was philosophically wrong. The second case refers to the 1996 Sokal hoax, and will show why Alan Sokal was right.

Causal Pluralism in Political Science: Integration or Incommensurability?

Crasnow Sharon
Arts, Humanities, and World Languages, Norco College, Norco California, USA

In A Tale of Two Cultures: Qualitative and Quantitative Research in the Social Sciences, Gary Goertz and James Mahoney argue that there are fundamental differences quantitative and qualitative research traditions in political science. These differences include different sets of values, beliefs, and norms that result in different research procedures and practices and thus the different traditions might be characterized as constituting different cultures. The result is that while within tradition conversations are often rich and productive, across traditions conversations are typically "difficult and marked by misunderstanding"(2012, 1).

One area in which these differences are particularly apparent is in the approaches taken to the investigation of causes. While quantitative researchers typically seek effects-of-causes through methods that identify average effects, qualitative researchers are often more focused on causes-of-effects, questions of how a particular hypothesized causal factor might give rise to a particular effect within an examined case. Quantitative researchers are thus concerned with causal relations at a population level whereas qualitative researchers are focused on events at the level of individuals.

Such pluralism within disciplines has recently been examined by Sandra Mitchell (2009), who argues for "integrative pluralism," and Helen Longino (2013), who suggests that in at least some cases different approaches are fundamentally incommensurable. I consider the question of how to think about different approaches to causality in political science using the work of Mitchell and Longino as a framework. I sketch a procedure for thinking about whether and when approaches can be integrated by identifying two dimensions to consider: how the objects of inquiry are conceived and the inferences that different concepts of causality can support. Questions of integration or incommensurability will depend on these factors and communication between the "two cultures" of political science may be facilitated through their consideration.

Analytic Method

Kosterec Miloš
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In science and philosophy, it is a common practice to qualify certain kinds of (scientific) methods (e.g., descriptive statistics, logical inference, etc.) as analytic. Among analytic methods we usually include, for example, defining, explicating, proving, conceptual analysis. However, if anyone is further required to specify what it means for a method to be analytic, she may find it difficult to formulate some general characteristics of analyticity as applied to methods.

The definition of analytic method should respect the following requirements: Firstly, it should permit that, by using analytic methods, one may gain epistemic progress. Secondly, it should comply with the intuition that analytic methods do not involve empirical investigation of the world.

The identity of the method is based on its parts and the structure according to which the parts are put together. Assuming that method consists of instruction, the database model of instruction is proposed. Instruction is represented as a state-changing operator having a possible impact on two databases. Now it is argued that analytic method is one consisting only of instructions that are analytic. Assuming that an explicit database of actual knowledge is distinguished from an implicit database of possible knowledge, analytic instruction can be defined as instruction that does not change the content of the implicit database. This view on analytic methods is compatible with the idea that epistemic progress is modelled as a change of state of the explicit database. This change can, but need not, be correlated with the change of state of the implicit database.

Can Scientific Rationality be Subsumed under Instrumental Rationality?

Seselja Dunja
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Epistemic instrumentalism (EI) is one of the common normative frameworks for expressing scientific rationality and, in particular, scientific methodology. The basic idea is to express epistemic rationality: "One is rational in believing/accepting P iff P is supported by the evidence." as a type of instrumental rationality:

"One is rational in believing/accepting P iff believing/accepting P is conducive of one's cognitive goals." Such a reductionist approach to epistemic rationality has especially been endorsed by the proponents of naturalized epistemology and philosophy of science, such as Laudan and Giere. While an early criticism of EI came in the 1990s from Siegel, Kelly (2003) posed much more serious challenge (strengthened by Lockard (2013)). Nevertheless, Kelly's remarks have remained unaddressed by philosophers of science, while EI has remained prevalent. The aim of this paper is to examine to which extent Kelly's objections apply to epistemic rationality in the context of scientific inquiry and which consequences they have for a naturalized approach to scientific methodology. We show that, first, in the context of science EI indeed faces the problems pointed out by Kelly and Lockard. Second, we root the source of these problems in the requirement of EI that one's rationality is to be assessed only in view of one's cognitive goals (i.e. the goals in an evaluation are agent-dependent). In view of this we will investigate possible ways out for normative naturalism. We will argue that while naturalized philosophy of science relies on means-ends rationality, it does not rely on the agent-dependency of goals, and hence it does not rely on EI. Nevertheless, epistemic rationality can be expressed as a means-ends rationality (i.e. in an epistemic consequentialist manner) in such a way that the ends do not necessarily belong to the agent's cognitive goals. Finally, we will show that preserving the distinction between epistemic non-instrumentalist and epistemic instrumentalist scientific rationality has important implications for scientific methodology, which have been neglected by both philosophers of science and epistemologists.

B1.12 METHODOLOGY

Thursday, August 6 • 11:00–13:00
Main Building, Room 7

Causal inference and public policy: problems and (some) solutions

Malinsky Daniel
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Causal search algorithms have proved to be fruitful in discovering causal relationships among variables in complex systems. One hope is that information produced by these methods could be put to use in advising policy decisions, i.e., deciding which interventions (if any) might effectively and efficiently achieve particular policy goals. For example, health policy makers might be interested in whether interventions on atmospheric pollutants (perhaps by means of policies which cap factory emissions) or mandatory exercise programs will affect asthma rates in urban youth. In order to make such comparisons, we would like ways to estimate the magnitudes of causal influence for different factors. Standard methods based on multiple regression are inadequate for this purpose, because they fail to correct for bias from unmeasured confounders. Current causal search algorithms based on probabilistic independence information only go part way because the causal structure is generally underdetermined by independence facts. In other words, a given observational data set can be compatible with many different causal structures, represented in the causal search literature by an "equivalence class" of graphical models. The problem is even more complicated when there may be causally relevant but unmeasured factors lurking in the system – a ubiquitous circumstance in social statistics.

I propose an automated method that combines a causal search algorithm with regression in order to estimate the magnitude of intervention effects from observational data. I describe the challenges posed by underdetermination in realistic contexts, and show how my algorithm deals with these challenges. Essentially, my procedure employs a kind of worst-case/best-case reasoning to provide bounds on estimates for intervention effects. I also explore the performance of my procedure on simulated data, and consider what further improvements or generalizations are needed to address the challenges of real-world policy evaluation.

Gender index for the academia : how to translate the real world into numbers?

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This paper is based on the experience of research in EU-funded projects about gender and science over the last ten years and present epistemological reflections on the creation of indicators and indexes. Measuring progress has become virtually an obligation for such projects, but defining appropriate indicators is not only a technical issue, it also implies philosophical considerations as replacing a description in words by a description in numbers creates a new social reality (Desrosières 2008). It also produces new possibilities for comparison through the commensuration process (Espeland & Stevens 1998). New spaces for equivalence and comparison are created, where ranking and benchmarking become possible. The effects of such equivalence making may be the idea of equal opportunities between the different terms; it may be also competition, ranking and the requirement to achieve a given norm. Statistical data is therefore used as evidence and as an instrument of governance (Porter 1995).

Such a perspective must be challenged at different levels. At the level of the construction of classifications, translation into numbers does not construct a reflection of the world; it transforms the world and reconfigures it a different way. This process requires discussion and consensus on adopted conventions (Desrosières 2008). At the level of policy making, it creates decisions to improve indicators and rankings, which does not always imply improving the experience under measurement. The aim of this paper is to discuss and to test the indicators, the conceptual frameworks, the data sources and the methodologies experienced in the GenderTime project (2013-2016). The project experienced the translation of the categories used by the EIGE (European Index for Gender Equality) into relevant categories for the measurement of gender in the academia. We will discuss the benefits and the shortcomings of this experiment, the new conventions and the new representations it has created.

Automated large scale evidence aggregation in the context of policy making

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Steele Katie
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The recent debate on evidence aggregation has mainly focused on two puzzles. On the one hand, Stegenga (2013) has argued that an analogue of Arrow's impossibility result holds for evidence aggregation, i.e. there exists no aggregation function which satisfies a set of intuitively plausible criteria. On the other hand, it is asked how we can pool probabilistic information provided by the evidence into a single probabilistic statement (e.g. Dietrich and List 2014). Our paper complements these debates by focussing on two salient features of evidence aggregation in the context of policy making: a) the large amount of available evidence from different sources with varying quality and b) the fact that for evidence aggregation in policy making we are interested in the guidance for well-defined, individual cases.

The starting point of our discussion is Hunter and Williams (2013) recent ambitious work on evidence aggregation in medicine. They propose a computational, and hence automated, method of evidence aggregation based on a formal approach of argumentation which yields, for a given set of evidence, a concrete answer to a particular case of treatment. We use their approach to build a formal model of the inference pattern of evidence-based policy making. This model allows us to identify a set of issues every procedure of aggregation in the context of policy making should address. With this in place, we examine under what conditions it is plausible to deliver an automated evidence aggregator capable of aggregating large volumes of evidence to yield an answer to a practical question. In the final part of the paper, we argue that these conditions point to the importance of striking a particular balance between simplicity, flexibility, and transparency in automated evidence aggregation to yield a superior result to carefully scrutinizing a small number individual studies.

The methodology of the logical and cultural dominant in cross–science communication

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Griftsova Irina
Department of Philosophy, Moscow State Pedagogical University, Moscow, RUSSIAN FEDERATION

This paper considers the methodology of the logical and cultural dominant as a new, non-classical, and humanities-based unit of methodological analysis. The study aims to demonstrate that completely different sciences can have common presuppositions (premises) and focus on a common problem. Such dominant can manifest itself in different contexts of use and depend on them, which does not exclude the possibility of finding – according to Wittgenstein's principle of "family resemblance" – mediated similarities between problems in different fields of knowledge. Thus, it becomes possible to demonstrate the permeability of borders between different areas of the humanities-based culture and their striking similarity in solving certain problems. For the purpose of analysing different fields of the humanities-based culture from the perspective of identifying common problems, we introduce the concept of the logical and cultural dominant (LCD). This work presents a method for identifying what we call the logical and cultural dominant. The paper provides a general overview of the LCD, analyses its function in culture, and describes its role in the communicative space. It is shown that, in culture, the LCD determines the features of communication both within the education system and in the field of science and theory. It becomes possible as a result of developing a methodology of logical and cultural dominant (MLCD) on the basis of the LCD.

The LCD is aimed at analysing cross-science relations and identifying conditions for the translation of certain ideas between sciences and different layers of culture. All of it makes it possible to interpret the LCD as a methodology adequate for solving inter- and transcdisciplinary problems and identifying the features of cross- science communications. Critical thinking and informal logic are regarded as main instruments in the LCD methodology.

B2
B2.1 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Tuesday, August 4 • 11:00–13:00
Main Building, Room 15

Nagelian reduction and coherence

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Two related questions are investigated: first, how does a Nagelian reduction of one theory (T1) to another (T2) impact on the coherence of T1 and T2? And second, it can be argued (cf. Dizadji-Bahmani et al. (2010)) that an increase in coherence is one goal that drives reductionist enterprises; consequently, the question if and how this goal is achieved can serve as an epistemic criterion for evaluating a purported reduction.

In order to answer these questions, I give a probabilistic analysis of the relation between the reduction and the coherence of two theories. Different measures of coherence have been proposed(e.g. Shogenji (1999), Olsson (2002), Fitelson (2003)); I argue that the most promising approach is axiomatic (cf. Bovens, Hartmann (2003)). However, since there are counterexamples to each proposed coherence measure, we should be careful that the analysis be sufficiently stable. It turns out that this can be done.

Coherentism, pluralism and the problem of measure sensitivity

Schippers Michael
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Propositions cohere to the extent they agree or dovetail with each other. The concept of coherence plays an important role in the theory of epistemic justification, theory appraisal and legal reasoning. The last 15 years have seen a large number of probabilistic proposals trying to explicate the notion of coherence, which is notorious for its elusiveness. In evaluating these proposals, the reference to particular test cases has more and more been replaced by a study of adequacy constraints. Unfortunately, however, it turned out that for each adequacy constraint there is at least one extant measure violating it. Moreover, it can easily be shown that the set of common adequacy constraints, albeit intuitively well-motivated, is plainly inconsistent. In this talk I discuss some recent results that are intimately connected with the problem of measure-sensitivity, as prominently discussed in the literature on Bayesian confirmation theory. To this end I focus on adequacy constraints highlighting the relationship between coherence on the one hand and concepts such as probabilistic independence, logicality, truth- and reliability-conduciveness, inconsistency and disagreement on the other.

After presenting some formal results I address the question of how to interpret them. More precisely, I argue that the problem of measure sensitivity, as it affects probabilistic measures of coherence, should be considered an argument for (a moderate) pluralism with respect to the underlying explicatum.

Carnap's Relevance Measure as Probabilistic Measure of Coherence

Koscholke Jakob
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It is generally assumed that Tomoji Shogenji was the first author to present a probabilistic measure of coherence suggesting to calculate the coherence of a set of propositions in terms of the deviation from their joint probabilistic independence. This paper, however, points out that roughly half a century earlier Rudolf Carnap already had a function based on the very same idea, namely his well-known relevance measure. This function is often overlooked in the coherence debate because it has been proposed as a measure of evidential support and still is misconceived as such. The goal of this paper is therefore to show that Carnap's measure is better understood as a probabilistic measure of coherence. For this purpose the measure is generalized and shown to be closely related to Shogenji's coherence measure: both measures satisfy and violate a similar collection of adequacy constraints and perform similarly in a series of test cases for probabilistic coherence measures; Carnap's measure even performs slightly better than Shogenji's in certain respects. Moreover, by conducting a Monte Carlo simulation Carnap's and Shogenji's measure can be shown to be highly correlated with each other and with several prominent probabilistic coherence measures such as e.g. Douven and Meijs', Fitelson's, Glass' and Olsson's and Roche's.

B2.2 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Tuesday, August 4 • 14:30–16:30
Main Building, Room 14

Intervention and Decision

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In 1994, Christopher Meek and Clark Glymour published a paper in which they argued that the difference between evidential and causal decision theory could be understood in terms of the different operations of conditioning and intervening on a causal graph. I develop their proposal to understand causal decision theory in terms of interventions. I show how this approach can be used to defend causal decision theory against standard counterexamples, such as Newcomb's problem. More importantly, the interventionist framework helps us to clarify the problem in a number of ways. It helps us to distinguish between different interpretations of the set-up of the problem; and it helps us to understand precisely what question causal decision theory is trying to answer. I appeal to Woodward's theory of interventions to define when interventions are and are not possible. I show how causal graphs can be used to extend causal decision theories to certain kinds of unusual cases where one has knowledge about how

one's actions will turn out, for example, in cases involving time travel. Final, I will use the interventionist framework to describe a new type of case where causal decision theory seems to give bad recommendations.

Causality as a theoretical concept, intervention assumptions, and empirical content

Gebharter Alexander
DCLPS, University of Duesseldorf, Duesseldorf, GERMANY
Schurz Gerhard
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In [anonymized] we argued that causality, as characterized within the theory of causal nets (TCN), satisfies two commonly accepted standards for theoretical concepts. In particular, we argued that (i) assuming directed binary causal relations obeying Spirtes, Glymour, and Scheines' (2000) causal Markov condition and causal minimality condition provides the best explanation of two statistical phenomena, viz. that two correlated variables X and Y become independent when conditionalizing on a third variable Z (screening off), and that two independent variables X and Y become dependent after conditionalizing on a third variable Z (linking up). In the second part we showed that (ii) TCN's core, i.e., the conjunction of the causal Markov condition and the causal minimality condition, is empirically empty. When one adds further axioms (such as different versions of faithfulness or the assumption that causation is forward directed in time) one gets, however, enriched TCN versions that have successively increasing empirical content. The first part of this talk summarizes and illustrates these findings, while the second part provides new results about TCN's empirical content. In particular, we present several theorems showing which logically possible probability distributions are excluded when assuming independence of human interventions: All (or most) of a person's actions manipulating variables of a person-external causal system that are experienced as "free" are probabilistically independent of those variables of the system that are non-effects of these action.

Constructing Causal Variables

Eberhardt Frederick
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Standard discussions of causal discovery presume that the world has already been represented in terms of causal variables whose causal relations are now to be determined. For example, in the now widely used causal Bayes net framework (Spirtes et al. 2000, Pearl 2000), it is assumed that one starts with a set of well-defined causal variables, for which statistical measurements are available, and the aim is to find the causal structure among those variables. Very little has been said about how one comes to find or construct these causal variables in the first place. It is known that the construction or determination of causal variables cannot be arbitrary, as a misspecficiation of the causal variables -- such as when a variable is in fact a mixture of two others -- can lead to erroneous inferences in the discovery methods. In this presentation I will give a positive account of how one can construct causal macro-variables from a set of micro-variables. I will illustrate this approach using image data as an example, where the pixels constitute the micro-variables, while the causal macro-variable is some higher level feature of the image. The account builds on the framework of computational mechanics developed in Shalizi (2001), but develops it to provide a more explicitly causal interpretation. The overall aim is to provide an automated approach to the construction of causal macro- variables from a set of micro-variables, that can be directly applied to the causal analysis of image and video data.

A Principled Approach to Defining Actual Causation

Beckers Sander
Computer Science, KULeuven, Leuven, BELGIUM
Vennekens Joost
KULeuven, Leuven, BELGIUM

The last decade has seen a proliferation of definitions of actual causation, yet little progress has been made in finding common ground between them. This is mainly due to the lack of a proper method for evaluating definitions on a fundamental level, as opposed to merely keeping tally on complex and exotic examples. We propose a principled way of building a definition from the ground up. First we define and motivate two essential concepts that outline the search space to look in: counterfactual dependence, which is a sufficient condition for actual causation, and production, which is a necessary condition. The first of these is commonplace in the literature. The second is a generalization of a concept introduced by Hall, which we show to be a special case of ours. We argue that in most cases both concepts occur together, and that the problem cases from the literature appear when there is only production (eg., Preemption, Switches, Overdetermination, etc.). The relevance of counterfactual dependence is easily understood in light of its similarity to predictive practices in science and engineering. Production, on the other hand, captures the more complex intuition of "bringing something about", which plays an important role in fields where counterfactual dependence is far less useful and/or harder to establish, such as history, ethics and medicine. Second, we develop a definition of actual causation as a suitable compromize between these two concepts. We do so by formulating two principles which constrain the space in the spectrum between them to a single definition. Third, we make all of this formally precise by using the expressive language of CP-logic (Causal Probabilistic logic), and prove that the principles introduced lead to our proposed definition. Finally, we compare several well-known definitions in the counterfactual tradition by locating them on the proposed spectrum.

B2.3 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Tuesday, August 4 • 17:00–19:00
Main Building, Room 14

Expediting the Flow of Knowledge versus Rushing into Print

Heesen Remco
Philosophy, Carnegie Mellon University, Pittsburgh, PA, USA

Sociologists have observed that scientists are subject to conflicting norms. One such conflict appears in the norms surrounding the sharing of scientific results: fast dissemination is imperative, but publishing too quickly is frowned upon. As Steve Fuller puts it: "the scientist is supposed to both expedite the flow of knowledge and not rush into print. But how can he expedite without also rushing?"

Although the question is intended to be rhetorical, this paper aims to answer it. I show first that both the incentive to expedite and the incentive not to rush are consequences of the priority rule: the principle that credit for scientific results and discoveries is awarded only to the scientist who first obtains them. This allows for a rational tradeoff: a rational (in the sense of credit-maximizing) scientist will share results at a speed that finds an optimal balance between expediting and rushing.

Under some plausible assumptions, the balance that is optimal for the individual scientist will be suboptimal from a social perspective. In particular, I argue that we have reason to believe that scientists will rush into print more than we want them to, leading to less valuable scientific work getting published.

This naturally raises the question of whether we can tweak the reward structure of science in such a way as to achieve alignment between the individual and the social optimum. I consider some ways in which one might do this.

Decision Theoretic Analysis of the Productivity Puzzle

Bright Liam
Philosophy, Carnegie Mellon, Pittsburgh, USA Carole Lee, Washington, Seattle, USA

It is a well confirmed phenomenon that, on average, scientists who are women produce less research papers than scientists who are men. The productivity puzzle consists in explaining why this productivity gap occurs. One explanation that has been suggested is that women are, on average, less scientifically proficient than men. This suggests investigation as to why this should be, and prompt policy interventions designed to improve scientific education for women. Another explanation is that various gatekeeping mechanisms designed to ensure that only quality work is accepted for scientific publication are biased against those perceived to be women, biased in favour of those perceived to be men, or both. This would suggest investigation into exactly how this bias operates, and prompt policies to strengthen the anonymity of scientific peer review. How one solves the productivity puzzle is therefore important to the direction of future research in science studies, and the sort of policies which should guide scientific governance.

In this paper we construct a decision theoretic model of an explanation for the productivity puzzle suggested by Carole Lee. Lee hypothesised that women concentrate on producing high quality papers in response an expectation that their work will be subject to biased treatment and hence receive greater scrutiny. The cost of this, however, is that to produce such work is especially time consuming and thus women produce less papers overall. We produce a model designed to mirror the strategic situation faced by scientists deciding how to allocate their effort between projects, and show that such an expectation of bias would have the result Lee hypothesised. To do this we make use of ideas drawn from the credit economy models of scientific research found elsewhere in the formal social epistemology of science. We argue that our model can explain the observed phenomena while preserving a fundamental egalitarian belief that differences in scientific proficiency do not track gender.

Defending The Semantic View Of Theories. A Computer Science Perspective

Angius Nicola
History, Human Science, and Education, University of Sassari, Sassari, ITALY
Stefaneas Petros
Department of Mathematics, National Technical University of Athens, Athens, GREECE

This paper takes current applications of the semantic approach to the construction of empirical theories of software systems (Angius and Stefaneas 2014) to address some recent objections directed against the modeltheoretic view of scientific theories. Halvorson's (2012) logic examination turned to underline how the semantic view fails to grasp equivalences of theories is replied in the context of the algebraic Theory of Institution, an abstract model theory developed for program specification languages. Galois connections in a given institution are shown to establish equivalence relations between theories syntactically and semantically defined. Krause's and Bueno's (2007) objection that a semantic theory presupposes a syntactic formulation of the same theory is replied by showing how semantic presentations are epistemically independent from axiomatic formulations in so far as models are hypothetical structures involved in the discovery of those axioms. Finally, Morrison's

(2007) dichotomy between theories, representing and explaining classes of empirical phenomena, and models, representing and explaining single phenomena pertaining to some physical sub-system, is recomposed by an extensive examination of Suppes' (1962) abstracting hierarchies of representational models in modular semantic theories.

References: Angius, N., & Stefaneas, P. (2014). Discovering Empirical Theories of Modular Software Systems. An Algebraic Approach. In Müller, V. (ed.), Computing and Philosophy: Proceedings of IACAP 2014. (Synthese Library) Springer: Berlin. (forthcoming). Halvorson, H. (2012). What Scientific Theories Could Not Be. Philosophy of science, 79(2), 183-206. Krause, D., & Bueno, O. (2007). Scientific theories, models, and the semantic approach. Principia, 11(2), 187-201. Morrison, M. (2007). Where Have All the Theories Gone?*. Philosophy of Science, 74(2), 195-228. Suppes, P. (1962). Models of data. In E. Nagel, P. Suppes, & A. Tarski (Eds.), Logic, methodology, and philosophy of science: Proceedings of the 1960 International congress (pp. 252–261). Stanford University Press: Stanford.

B2.4 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Saturday, August 8 • 10:00–12:00
Main Building, Room 8

The Infference to the Best Explanation: The Problem of the Description of Evidence to be Explained

Rodrigues da Silva Marcos
Philosophy, UEL, Londrina, FINLAND

One of the central problems of the realism/anti-realism debate is the acceptance of scientific theories: What should the epistemological attitude of a scientist before a successful scientific theory be? Realists argue that the acceptance of an instrumentally successful theory implies the belief in its truth. An important realistic argument is that of the inference to the best explanation, formulated by Gilbert Harman, and from his statement we may then introduce the following argument: a) evidence E must be explained; b) hypothesis H explains E better than all other concurring hypotheses; c) conclusion: H is liable to the belief in its truth. This communication intends to present a difficulty in the establishment of premise (a) mentioned above, regarding the argument of the best explanation. The difficulty would be that the description of any evidence that needs to be explained cannot always be shared by the scientists that are involved in the search of such explanation. Thus, even though those scientists share the recognition of the importance concerning the specific evidence, the diversity of their investigative interests could lead them to assimilations that are distinct from the results of the research on the evidence. In the present work, the results of a historiographical investigation are presented and are intended to support the philosophical discussion about the assimilation, by some scientists in the beginning of the years 1950, of the statement proposed by Ronald Giere – "The X-Ray patterns of the DNA molecule must be explained" – to describe one of the main scientific problems in the molecular genetics.

A dialogic approach to abduction

Duarte Calvo Antonio
Logic and Philosophy of Science, Universidad Complutense de Madrid, Madrid, SPAIN

In this paper, abduction is analyzed integrating it within dialogue models. To do this, I consider abductive reasoning as a process of dialogue that moves forward as we are making / answering certain questions. It is crucial to take into account three essential characteristics of the abductive reasoning: it is plausible, tentative, and in consequence it is open to new data, and relative to a given context. I argue, therefore, that all abductive reasoning develops in a dialogue, which can be explicit or implicit (elliptical), and it will be within this framework from which should be considered. It is in this discursive context in which the "instinct" for the assumption or divination becomes conscious, voluntary and ultimately, logical. Therefore, it is from this perspective that can

be analyzed and criticized at every turn. If there is a character that agglutinates an exceptional abductive capability inside a dialectical frame, he is Sherlock Holmes. From one side, in his large number of cases we find an exemplary abductive methodology; on the other side, this methodology is contrasted and tested at every step and, at the same time, explained aloud within a persuasion dialogue in which Watson acts as a light conductor. As Sherlock Holmes declares in Silver Blaze: «Nothing clears up a case so much as stating it to another person». In summary, abduction, persuasion dialogue and Sherlock Holmes as a hinge in between will be the focus on this contribution. The first thing that I would like to show is that the abduction is an immediate inference to the best explanation that can (and must) be tested with a logical and methodological analysis; the second, it is that abduction takes place in a dialectical process which can be explicit or manifest or, alternatively, implicit or latent.

Representation and reconceptualization: the role of structures

Pero Francesca
Philosophy, University of Florence, Florence, ITALY
Knuuttila Tarja
Philosophy, University of South Carolina, Columbia, USA
Castellani Elena
Philosophy, University of Florence, Florence, ITALY

In this paper, we focus on the notion of structure as employed when considering models and representation in science. Structuralist approaches to scientific theories have a long and respectable tradition in the philosophy of science. In particular, the semantic view of scientific theories and recent versions of structural realism have notoriously contributed to the philosophical interest in the role of structures. Which kind of structure to consider with respect to models, and how this structure is used and related to a target system in order for the model to "represent", is a crucial point in the relevant literature. We focus on this very point and argue that a source of confusion in current debates has to do precisely with a misleading use of structures. More precisely, we find this use misleading in a twofold sense. First, for not clearly distinguishing between the two levels at which the use of models (and related structures) takes place: the "object-level" of working scientists, where scientific theories are elaborated and tested, and the "meta-level" of philosophical analysis, where the results presented at the object-level are reconceptualized in terms of abstract structures such as sets or categories (we follow here the terminology used by French (2012) to distinguish the two levels). Second, for inadequately identifying the relevant structures at stake when considering the representational function of models. We argue for this point by using examples from physics, biology and economics.

References: French, S. (2012), The Presentation of Object and the Representation of Structure, in Landry, E. and Rickles, D. (eds.), Structural Realism, The Western Ontario Series in Philosophy of Science, vol. 77, pp. 3-28, Springer, the Netherlands.

Varieties of Misrepresentation and Homomorphism

Suárez Mauricio
Institute of Philosophy, School of Advanced Study, London, UNITED KINGDOM
Pero Francesca
University of Florence, Florence, ITALY

This paper is a critical response to Andreas Bartels' (2006) sophisticated defence of a structural account of scientific representation. We show that, contrary to Bartels' claim, homomorphism fails to account for the phenomenon of misrepresentation. Bartels claims that homomorphism is adequate in two respects. First, it is conceptually adequate, in the sense that it shows how representation differs from misrepresentation and nonrepresentation. Second, if properly weakened, homomorphism is formally adequate to accommodate misrepresentation. We question both claims. First, we show that homomorphism is not the right condition to distinguish representation from misrepresentation and non-representation: a "representational mechanism" actually does all the work, and it is independent of homomorphism – as of any structural condition. Second, we test the claim of formal adequacy against three typical kinds of inaccurate representation in science which, by reference to a discussion of the notorious billiard ball model, we define as abstraction, pretence, and simulation. We first point out that Bartels equivocates between homomorphism and the stronger condition of epimorphism, and that the weakened form of homomorphism that Bartels puts forward is not a morphism at all. After providing a formal setting for abstraction, pretence and simulation, we show that for each morphism there is at least one form of inaccurate representation which is not accommodated. We conclude that Bartels' theory – while logically laying down the weakest structural requirements – is nonetheless formally inadequate in its own terms. This should shed serious doubts on the plausibility of any structural account of representation more generally.

References: Bartels. A. (2006), Defending the structural concept of representation. Theoria, 55:7–19.

B2.5 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Wednesday, August 5 • 17:00–18:30
Main Building, Room 12

An Economic Interpretation of Contrapositive Probability

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Although the probability function $p(h \mid e)$ has always been a popular measure of the relation between a hypothesis h and an item of evidence e, variants of the contrapositive probability $q(h \mid e) = p(\neg e \mid \neg h)$ have been entertained in various contexts by several writers, for example, Hempel & Oppenheim (1948), Reichenbach (1954), Hilpinen (1970), and Miller & Popper (1986). It is straightforward to formulate axioms for the function q, in particular, the law of bounds, $0 \leq q(h \mid e) \leq q(h \mid h) = q(h \mid \bot) = 1$, the general addition law, $q(h \mid e) + q(h \mid d) = q(h \mid e \vee d) + q(h \mid e \wedge d)$, and the general multiplication law $q(h \mid e \vee d) = q(h \vee e \mid d)q(h \mid e)$.

The aim of this paper is to propose an economic interpretation of the values of q that can sit comfortably beside the standard interpretation, underwritten by the Dutch book argument, of probability distributions as coherent systems of betting rates. In an undistorted market, the price of an item may have to be discounted when the purchaser already possesses part of what is being bought. It will be shown that if the items for sale constitute a Boolean algebra then the rate at which the rational merchant in possession of the item e will discount the price of the item h is given by a function that satisfies the axioms for the function $q(h \mid e)$. As a consequence, $1 - q(h \mid e)$ may be understood as a measure of the informative value of the hypothesis h in the presence of the evidence e, ranging from 0 when e implies h to 1 when e and h are maximally independent, that is, when they have no non-tautological consequences in common.

Betting odds and sincere degrees of belief

Elliot Colin
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In subjective probability theory, probabilities are interpreted as an agent's degrees of belief over the occurrence of an event or the truth of a proposition. It is usually assumed that degrees of belief can be elicited from an agent by proposing her an appropriate bet. But is this a good operational definition? Should a rational agent declare her sincere degrees of belief if offered a bet? Without modifying the classic betting set-up, I model a rational agent as making very simple and general assumptions about the bookie. I make these modeling assumptions: the agent is an expected utility maximizer; she assumes that the bookie is also an expected utility maximizer; and she thinks that the bookie's degree of belief about the event they are betting over could be anything between 0 and 1, with uniform probability. In the classic set-up, the bookie decides the direction of the bet upon viewing the agent's betting price. This means that the agent does not know if she will win or lose even if the event occurs. This is supposed to force the agent to express her genuine credence. But perhaps the agent should reason about the direction of the bet, especially if she wishes to maximize her gains. So how does the bookie decide this direction? Given my assumptions, we have a simple model of his behavior. We can then calculate the maximum expected gain for the agent from a single bet; we see that, in nearly all cases, it is not obtained by the agent declaring her sincere credence as betting odds. I conclude that in the classic betting scenario, an agent generally should not declare her sincere degree of belief as her betting odds. This suggests that betting odds, although numerically convenient, constitute a bad operational definition for sincerely held credences.

Making Fit Fit

Hicks Michael
Philosophy, Rutgers University, Brooklyn, USA

Reductionist accounts of objective chance rely on a notion of fit, which ties the chances at a world to the frequencies at that world. Here, I criticize extant measures of the fit of a chance system, and draw on recent literature in epistemic utility theory to propose a new model: chances fit a world insofar as they are accurate at that world. According to the view I defend, the objective chance function is that probability function which maximizes accuracy while respecting norms of evidence. I show how this model of fit underwrites Pettigrew's recent proof of the principal principle, sits well with reductionist views about laws of nature, and explains chance's role as an expert function.

B2.6 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Friday, August 7 • 17:00–19:00
Main Building, Room 15

I believe successfully ergo I know: A quest for lasting and successful belief

Parikh Rohit
Computer Science, The City University of New York, New York, USA
San Ginés Ruiz Aránzazu
Filosofía 1, Universidad de Granada, Granada, SPAIN

In 1994, Rohit Parikh proposed a criterion of knowledge which emphasized the idea of successful behavior. But this idea is actually quite old and has its roots in Peirce. We modify Parikh's 1994 idea, and develop it to provide a more general understanding of what is usually called 'to know that ...'. In order to do this we distinguish among three possible ways in which a belief can be said to be successful at a time 't' that depend upon the relative position of the agent who evaluates the belief. We distinguish among:

1) an agent who evaluates someone's belief according to internal conditions at a particular time (first person perspective);

2) an agent who evaluates someone's belief according to external conditions at a particular time (second person perspective);

and finally 3) an agent who evaluates someone's belief according to external conditions over an interval of time (third person perspective).

Of particular interest to us will be our analysis of the third person perspective since, we contend, this perspective guides an answer to the fundamental question of the goal of the cognitive efforts linked with Science. However, this special interest should not dismiss the others, whose significance will be evidenced in our analysis of some examples. In particular, our approach will fit in nicely with some famously difficult cases by Gilbert Harman and Jason Stanley.

Finally, we will compare our pragmatistic approach, or partly compare (since ours is for now just the sketch of a theory), with Isaac Levi's theory of knowledge. Levi, like us, finds in Peirce an important inspiration, but also a pressing antagonist with whom to contrast some of his ideas. We will finish our talk attending to Levi's criticisms of Peirce, motivated by two of them: the epistemological infallibilism and the avoidance of error as an aim of inquiry.

Learning Credences and Betting Credences

Vassend Olav
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I argue that what credences it is rational for agents to have depends on what their goals are. In particular, I argue that we must distinguish between two fundamentally different kinds of credences: learning credences and betting credences. Learning credences are appropriate when our goal is to assign the highest possible posterior probability to the true hypothesis, whereas betting credences are appropriate when we intend to use our credences to determine what bets to accept and what bets to reject – or in other words, when our goal is to maximize utility. Specifically, I argue that if our goal is to find the true hypothesis through Bayesian updating, then the appropriate way to measure the difference between two credences is by using a logarithmic measure, and I show that we then have a strong incentive to avoid assigning any hypothesis a credence close to 0. On the other hand, if our goal is to maximize utility, then I argue that the appropriate way to measure the difference between two credences is by way of a linear measure, and I show that this removes our incentive to not assign hypotheses credences that are close to 0. The upshot is that our goals ought to influence what credences we take to be rational, and I give examples that show that we intuitively do let our goals determine what credences we take to be rational. Furthermore, I suggest two "objective" procedures that yield credences that, at least in many circumstances, appear reasonable. The first procedure, which is mathematically equivalent (more or less) to José Bernardo's "reference prior" approach, yields reasonable learning priors. The second procedure yields reasonable betting priors.

On the equivalence of various forms of learning in a probabilistic setting

Gyenis Balazs
Institute of Philosophy, Hungarian Academy of Sciences, Budapest, HUNGARY

Jeffrey conditioning is said to provide a more general method of assimilating uncertain evidence than Bayesian conditioning. We show that Jeffrey learning is merely a particular type of Bayesian learning if we accept either of the following two observations: - Learning comprises both probability kinematics and proposition kinematics.

What can be updated is not the same as what can do the updating; the set of the latter is richer than the set of the former. We address the problem of commutativity and isolate commutativity from invariance upon conditioning on conjunctions. We also present a disjunctive model of Bayesian learning which suggests that Jeffrey conditioning is better understood as providing a method for incorporating unspecified but certain evidence rather than providing a method for incorporating specific but uncertain evidence. The results also generalize over many other subjective probability update rules, such as those proposed by Field (1978) and Gallow (2014).

B2.7 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Wednesday, August 5 • 17:00–18:30
Main Building, Room 4

The logical form of physical statements

Benda Thomas
Institute of Philosophy of Mind, National Yang Ming University, Taipei, TAIWAN

The problem of logical representation of physical statements is given a novel account, described in an informal manner below.

Physical entities are not sharply defined and the ultimate physical theory--if it exists--is not known. Mathematical formulations of physical theories speak of models rather than physical reality itself. They are logically precise, but are at best mere approximations to physical reality. Their limits of accuracy are accepted by working physicists as long as they appear to be successful. Statements on daily observations are to be treated in the same way. Here, we generally don't doubt an--again only approximately described--underlying matter of fact.

I propose to take the found inaccuracy of both observational and scientific statements serious as inevitable when we search for the proper logical form of physical statements; furthermore, to adopt an agnostic stance regarding truth of statements about a supposed underlying physical reality--statements we do not have anyway. Thus we acknowledge that all physical statements concern only entities within models. They are evaluated not semantically--strictly speaking, they would be false--but by degrees of credence and include inter-theoretical identity relations.

Degrees of credence of physical statements are found dependent on context and according to our established practice of observation and building theories, finally forming a--rather complex--partial order. The complete structure also contains statements with fixed credence, e.g., "0 ? 0". Thereby, our practice of assigning credence to scientific and everyday physical statements is well represented.

The proposed stance is not necessarily anti-realistic. It merely concerns the proper logical form of physical statements. Success of theories is linked to aligning of scientific and observational beliefs, which we perform on a logical object level. The well-known riddle of physical theories being successful yet logically false thereby has a good prospect of being solved.

Counterfactuals within Scientific Theories

Fletcher Samuel C.
Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universität München, Munich, GERMANY

The language of our scientific theories is rife with alethically modal statements. The truth of counterfactual conditionals concerning matters that scientific theories describe, however, is not adequately given by the application of standard possible world semantics. As developed by Lewis and others, this semantics depends on entertaining possible worlds with miracles, worlds in which laws of nature, as described by science, are violated. This is clearly unacceptable if one is interested in evaluating certain counterfactuals not as sentences broadly of natural language, but more narrowly as propositions concerning only the connections between possibilities warranted by particular scientific theories.

Many scientific theories do describe the possibilities they warrant mathematically, and the practice of science itself often involves introducing additional structure on these possibilities to represent relevant similarities among them. These structures include so-called uniformities, which are used to introduce the concept of a uniformly continuous variation. Any uniform space—a collection with a uniformity—turns out to be a model of Lewis' system of spheres (or equivalently, his similarity measures), in particular his modal logic VWU. If the uniformity is separating—the uniform-structure analog of the Hausdorff condition from topology—then the corresponding system of spheres (similarity measure) yields Lewis' modal logic VCU. The possible worlds, however, are all consistent with the scientific theory of interest, so evaluating counterfactuals using them does not require entertaining miracles.

As for the choice of similarity measure (uniformity), the context of investigation can often determine which features of these models are relevant for answering a given question. A similarity measure can then be constructed to respect these relevant features. As an application, I consider the possibilities described by the theory of general relativity—relativistic spacetimes—where the relevant notion of similarity can be determined by approximation of classes of certain observable quantities.

Iterated Belief Revision and Nested Conditionals

Fu Hao-Cheng
Philosophy, Chinese Culture University, Taipei, TAIWAN

In this paper I aim to explore the relationship between iterated belief revision and nested conditionals. There are two motives in exploring this topic. Firstly, as we have seen in Knowledge in Flux written by P. Gärdenfors, it seems inconsistent if we join the Ramsey Test with the postulates AGM theory proposed due to adopt the monotonicity principle. In his viewpoint, Gärdenfors thought that the culprit is the Ramsey test and reject it as

the criterion in accepting conditionals, so we need more sophisticated way for an adequate analysis for conditionals. Secondly, some logicians and philosophers point out there is another problem in belief revision due the AGM theory could not provide a plausible method to undertake the problem of iterated belief revision. That is to say we need more than one selection functions if we want to deal with a sequence of information rather than only one single sentence to assimilate but unfortunately the selection function which AGM theory proposed is the so-called one-shot function. I propose to revise the revision function of AGM theory based on Spohn's ordinal conditional functions and to explicate the problems of nested conditionals.

B2.8 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Saturday, August 8 • 13:30–15:30
Main Building, Auditorium II

Reassessing lacunae problems for scientific theories.

Islas Damian
Philosophy, University of Toronto, Toronto, CANADA

My aim is to explore the logical nature of "lacunae problems" within scientific theories of the natural world. To do this, first I will characterize three different, but linked ways of conceptualizing lacunae. The first conceptualization comes from the germinal work of Larry Laudan (1977). The second from the constructivist project of Theo Kuipers (2000) and the third from the logical perspective developed by Atocha Aliseda (2005). As I will show, all these authors fail to identify what exactly is a lacunae. In order to help with this, I will develop some arguments from a cognitive perspective, with which we can approximate to identify the nature of lacunae problems. Finally, I will show that from a logical point of view, it is impossible to explain without contradictions, how it is that a lacunae may be consistent with a specific theory and at the same time it cannot be explained through the logical relations between the hypothesis (H), background knowledge (B), initial conditions (C) and empirical evidence (E) avaliable at t for that theory.

Reanimating Ayer's Significance Criterion

Justus James
Philosophy, Florida State University, Tallahassee, USA

The unmitigated failure of A. J. Ayer's significance criterion in Language, Truth, and Logic reveals the fundamental folly of any attempt to formulate such a criterion. This is the familiar, critical appraisal of the historically contentious search for a precise litmus test that would distinguish statements empirical observation bears on from others. But neither the specific indictment of Ayer's efforts nor the negative assessment of the general project should be accepted. Ayer's original proposals were certainly inadequate, but it is far from clear the deficiencies cannot be remedied by well-motivated amendments. Alonzo Church's decisive criticism was an early volley in a more than half-century exchange between proponents and detractors. Calling that series of conceptually and technically intricate maneuvers "the sorry history of unintuitive and ineffective patches," (Lewis 1988, 4) is neither charitable nor accurate. The project also merits a more receptive assessment in another respect. Before Ayer's and then Carnap's efforts, seemingly rudderless debates about what modalities were relevant in gauging empirical significance had made the need for precision, ideally formal precision, manifest. Rather than reflect reckless antimetaphysical fervor, compelling epistemological and methodological concerns rightly catalyzed the search for a formal criterion of empirical significance.

The Principle of Observability, the "Stage of Empirical Weightlessness of a Theory", and "Constructive Empiricism"

Pavlenko Andrey
Ontology, Institute of Philosdophy, Moscow, RUSSIAN FEDERATION

This work aims at analyzing the "principle of observability" (PO) from the formal point of view, making use of its explicit (ontological and epistemological) definitions: 1) The Strong Ontological Principle of Observability (SOPO); 2) The Week Ontological Principle of Observability (WOPO); 3) The Strong Epistemological Principle of Observability (SEPO); 4) The Weak Epistemological Principle of Observability (WEOP). It will be show that our contemporary interpretation of PO is directly associated with the so called "stage of empirical weightlessness of a theory" (SEWT).

SEWT : $_{\mathrm{Df}}$ 1) The new theory solves all or most part of the problems in the previous theory*;* 2) The new theory agrees with the principles of symmetry and the laws of conservation (of the other contiguous theories)*;* 3) The new theory includes the previous theory as a limitary case in its own explanation of the object reality*;*4) The new theory has a heuristics of its own (can predict *new empirical* facts(ϕ));5) The new theory *is accepted* (provided it possesses the above qualities) by the majority of the research community *E* in this field of science; But! 6) The new theory T_{new} does not have by far a single empirical verification for the newly predicted facts . The fact that SEWT exists allows us to give the weak epistemological formulation PO.

It will be shown, too, that it is SEWT exactly that offers ample opportunities in both justification of PO and justification of B.v. Fraassen's thesis:

$$\text{Emp Ad}\,(L) \rightarrow \text{Real}\,(X) \wedge \neg\,\text{Obs}\,(X).$$

Literature

Fraassen B.C. van, [1980], *The Scientific Image,* Oxford: Clarendon Press,
Fraassen B.C. van, [1985:]`Empiricism and the Philosophy of Science', in Churchland and Hooker,pp.245-308.
Muller F.A., [2004] Can a Constructive Empiricist Adopt the Concept of Observability?//Philosophy of Science,**71**,
Musgrave A., [1985]`Constructive Empiricism and Realism', in Churchland and Hooker ,: 196-208.

Suppes' latest production: probabilistic empiricism and experimental practices beyond formal methods

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Schiaffonati Viola
Dip. di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milano, ITALY

Patrick Suppes has certainly played a key role for the introduction of formal methods to discuss the foundations of science in the philosophical debate already from the last years of the 1950s, by proposing the use of set- theoretical methods, given their power in expressing systematic scientific results. We believe, however, that a better characterization of Suppes' approach can be found in his attempt to reconcile formal methods with empirical practice in the representation of science, which is evident in the latest production, especially in his attention to the theory of experimentation as a way of treating empirical practices through the use of formal methods.

According to Suppes, such theory should include: - a deep consideration of apprenticeship as a 'learning by doing' activity, which cannot be left out from the analysis; - a theory of experimental design, that should include the search for alternative hypotheses or methods and the establishment of a suitable test in order to choose the most efficient in terms of explanatory power or positive results;

- an appropriate theory of error, as an intrinsic constituent of the scientific inquiry, enabling to distinguish between genuine errors, that may be the result of an incorrect application of experimental procedures, and correct, though unusual, results of a measurement. Within this framework, we aim at rereading Suppes' probabilistic empiricism and the philosophical implications of his 'probabilistic turn' in sciences in the light of his recent studies on brain, rationality and behavior. A point of our contribution is to show how the indeterministic view and probabilistic empiricism together give as a consequence a new way to conceptualize causality, anchored on prediction, rather than on explanation.

B2.9 FORMAL PHILOSOPHY OF SCIENCE AND FORMAL EPISTEMOLOGY

Saturday, August 8 • 13:30–15:30
Main Building, Room 10

The Relatively Infinite Value of Nature

DesRoches Tyler
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Bartha Paul
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Some environmental ethicists and economists argue that attributing infinite value to the environment – claiming that it is priceless – is a good way to ensure an absolute obligation to protect it in the context of environmental decision-making (Hargrove 1989; Bulte & van Kooten 2000). Colyvan et al. (2010) argue against modeling the value of the environment in this way: the assignment of infinite value, even if meaningful, leads to immense technical and philosophical difficulties that undermine the environmentalist project. First, there is a problem of discrimination: saving a large region of habitat is surely better than saving a small region, yet if both outcomes have infinite value then decision theory appears to prescribe indifference. Second, there is a problem of swamping probabilities: an act with a small but positive probability of saving an endangered species appears to be on par with an act that has a high probability of achieving this outcome, since both have infinite expected value. Colyvan et al. raise further doubts about the coherence of the concept of infinite value, and conclude that it is a mistake to model the natural environment as infinitely valuable (rather than as having a large but finite value). Building on recent non-standard decision theory, our paper shows that a relative (rather than absolute) concept of infinite value is well-defined. When applied to certain features of the natural environment, it provides just the right model for securing the priority of the natural environment and avoids the failures of discrimination noted by Colyvan et al. Our claim is not that the relative infinite utility model gets every detail correct, but rather that it provides an important and rigorous philosophical framework for thinking about decisions affecting the environment.

Realistic Rationalism and Formal Science

Golovko Nikita
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The paper aims to explore new directions of research in the borderland between philosophy and science that are concerned with the problems of epistemological accessibility of the abstract objects and rational justification of formal (ironic, like string theory) science. We are following Jerrold Katz's [2000] dualistic view about the ontology of science. The formal science study abstract objects and the natural (empirical) sciences study concrete and composite (Reichenbachian) objects. The most common objection against the realist interpretation of formal science is that the perceptual inaccessibility of abstract object refutes realism because it exposes realist epistemology as a form of mysticism. Following Katz this argument rests on the false assumption that information from casual interaction with natural objects is necessary feature of justification in any form of knowledge. The knowledge in formal science asks which supposition is necessary, but not which possibility is actual. If we treat ironic science as a science of a special kind, for example, assuming Extended Hypothetical-Deductive model (mostly R.Dawid): theoretical schemes are underdetermined by theoretical underdetermination as well, etc., we may introduce an epistemological function of a "formal science object" which plays a leading role in the empirical procedure to choose between the appropriate epistemic stances aiming at the justification of the necessity of properties of such an object that revealed to us (Kosso). It is claimed that the epistemological function of the intellectual contact with an abstract object may be evaluated as a part of empirical procedure of interrogative games (Hintikka) concerning the justification of the ontological commitments in such a "strange" science. The ironic science is pretty effable, we just need to be more careful about what objects and what science we are talking about. Realism assumption will follow automatically as a good explanation of the progress of such a formal (ironic) science.

Inference based on content relations

Chevalier Jean-Marie
Philosophy, University of Helsinki, Paris, FRANCE

Inference has not been the object of much investigation lately. According to one approach, inference is based on particular concepts, and depends on the contents of certain premises. According to the opposite, more popular view, it does not depend on any concept but on applying a rule. Paul Boghossian, John Broome and Crispin Wright all have argued for such a (Wittgensteinian) conception of inference.

But they all face difficulties. Broome claims that a full-fledged theory of reasoning is required in order to define rationality. Boghossian's account may seem the most convincing one, but his "Taking Condition" is still very problematic. Because of such limits, I want to take a new glance at the somewhat overlooked view of inference as based on contents. Inferring q from p supposes that one 1) believes that p 2) believes that p justifies q (is a good reason for q –even though the basic relation may be discussed in this context) 3) believes that q 4) believes that q because of the belief that p is a good reason for q.

I examine several "formal" candidates for these four conditions. Following a rule is eventually dismissed. So is the approach is terms of logical form and in terms of truth values, according to the results of my analysis. I thus turn to "material" candidates, in the footsteps of Sellars' 1953 analysis of inference and meaning. I build the notion of "causal history" in order to express the material relation between premises and a conclusion, and test its efficacy on the famous example of Linda the bank clerk. I eventually make some restrictions on causal history in order to beat back relativism and maintain the requirement of normativity in reasoning.

Great Expectations

Rubio Daniel
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Chen Eddy Keming
Philosophy, Rutgers University-New Brunswick, New Brunswick, New Jersey, USA

Although expected utility theory has proven a fruitful and elegant theory in the finite realm, attempts to generalize it to include infinite utilities and infinite state spaces have resulted in many paradoxes. Nevertheless, some of the most venerable decision problems like the St. Petersburg Game and Pascal's Wager employ exactly these things. In this paper, we argue that the use of John Conway's surreal numbers allows us to provide a firm mathematical foundation for transfinite decision theory. To that end, we prove a surreal representation theorem, show that surreal decision theory respects dominance reasonings even in the infinite case, and bring our new resources to bear on one of the most puzzling and oft-discussed problems in the literature: Hajek and Nover's Pasadena Game. We show how to give the game a systematic, consistent value. Thus, we provide a fruitful new framework for thinking about infinite decision problems.

B3

B3.1 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Tuesday, August 4 • 14:30–16:30
Main Building, Room 12

Omissions as Causes

Vision Gerald
Philosophy, Temple University, Philadelphia, USA

Although absences are commonly cited as causes (e.g., "The gardener's failure to water the plants caused them to die"), objections abound to them as genuine causes. One concern is how what-is-not can have an actual effect. Another, the so-called proliferation objection, is why the gardener's non-performance is any more a cause than, say, the Queen's or anyone else who didn't water the plants. Against such criticisms I argue that omissions (using event-like nominalizations) can be fully legitimate causation and are not in need of further analysis as such. There are various ways to support this view. For this occasion I propose a two-pronged answer. (I cannot put forward all of the reasons for accepting omissive causes here.)

Re: the proliferation objection. Apart from counterfactual analyses of causation itself, causes must be supported by counterfactuals (with rare exceptions for cases of pre-emption and redundancy). Filling in this sketchy scenario, any counterfactual involving an agent other than the gardener is likely too remote (a possible world) to support a causal claim.

Second, and more systematic, for too long philosophy has acknowledged non-existences as undifferentiated. The term 'nothing' has been used promiscuously to cover all of it. However non-existence (absence) is more nuanced, and warrants grading. It is not inevitably what Lewis termed "a deadly void" that would suck up everything in its vicinity. Homespun cases include skipping a note at a music recital, missing a stop sign, or failing to submit a tax form on time. Once we sort out these differences, it is more difficult to dismiss omissive causes as Shakespearean Nothings. This opens a large issue and the most I can hope to do is to begin a discussion on why it is important to distinguish cases and how an adequately finely-graded formula might proceed.

The Inference to the Most Invariant Cause

Lanao Xavi
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Cartwright famously rejects the Inference to the Best Explanation (IBE) in favor of the Inference to the Most Likely Cause (IMLC) and argues that the IBE is not a reliable guide to the truth of the explanation selected by the inference procedure—only causal explanations can provide a reliable guide to truth. She argues that being able to manipulate theoretical entities provides the best possible evidence for the truth of the causal claims based on these manipulations (Cartwright 1983, p. 98). However, the IMLC has been heavily criticized for not providing independent epistemic criteria for inferring the likeliness of a causal explanation, which makes the IMLC either circular or vacuous.

My aim is to defend an updated version of Cartwright's IMLC as a reliable guide to causal relationships that overcomes the problem of circularity/vacuity. Psillos (2010) has proposed a solution to the circularity/vacuity problem that appeals to explanatory criteria (particularly understanding-conducive features) as a guide to inference. Contra Psillos, I argue that understanding-conducive features are many times not truth-tracking (e.g. in cases involving idealization) and, therefore, not reliable guides to the likeliness of the inferred causal explanation.

I propose an alternative account—the Inference to the Most Invariant Cause (IMIC)—that involves two major modifications. First, the IMIC focuses exclusively in the manipulative content of causal explanations, that is, the part of the content of explanations that is relevant (at least in principle) to manipulating and controlling nature. Second, it includes a version of Woodward's invariance condition (i.e. that relationships that are invariant under certain interventions describe actual causal relationships) as the main independent epistemic criterion for causal inference. These two conditions allow the IMIC to avoid Cartwright's circularity/vacuity problem without introducing explanatory features that can deviate the inferential process from truth.

Causation and Time Reversal

Farr Matt
Philosophy, University of Queensland, Brisbane, AUSTRALIA

On a standard interpretation of time reversal, time reversible theories radically underdetermine causal relations between events. This has led many to hold that time reversal symmetry makes causality redundant in physics. In this paper, I examine whether the problem of time symmetry can be resolved by taking a non-causal interpretation of time reversal.

Although causal hypothesis are definable and explanatorily useful in higher-level sciences, there's a popular thesis that causality plays no role in physics (e.g. Russell 1913, Norton 2007). Central to this is the claim that time symmetric theories cannot support a cause/effect distinction. However, causal models and causal principles are widely used within physics irrespective of whether the theories is questions are taken to be time symmetric, both in the case of classical physics (cf. Frisch 2014) and in quantum mechanics (cf. Leifer & Spekkens 2013).

My paper assesses whether time reversal symmetry is compatible or incompatible with causality by asking whether causal relations ought to invert under the action of time reversal or remain invariant. On a 'causal' interpretation of time reversal, causal relations are inverted by time reversal, and hence time reversible theories radically underdetermine causal relations. On a 'non-causal' interpretation of time reversal, time reversal does not invert causal relations, and hence time reversible theories pose no special problem for causality. I consider the tenability of this second option for the compatibility of time symmetry and causality.

Reichenbachian Common Cause Systems Compared

Stergiou Chrysovalantis
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In 2004, Hofer-Szabó and Rédei presented a generalization of the concept of statistical common cause, dubbed Reichenbachian Common Cause System (RHS-RCCS). Their aim was to explain causally statistical correlations that lack a traditional common cause. In 2012, Mazzola proposed a different account of the notion (M-RCCS) by modifying a condition in the definition of RHS-RCCSs. He argued for the new concept as being intuitively more appealing while retaining the explanatory efficacy of the old one. In the present talk I intend to compare the two rival approaches and to contribute to their clarification. I will present a finite RHS-RCCS of a correlation that is an M-RCCS and I will show that the infinite RHS-RCCS proposed by Wronski and Marczyk (2010) is also an M-RCCS; demonstrating, thus, that RHS-RCCS and M- RCCS are compatible notions. Furthermore, I will provide a case of an RHS-RCCS of a correlation that is not M-RCCS and a case of an M- RCCS that is not RHS-RCCS; demonstrating, thus, that the two concepts do not have the same extension and that no one of them is a special case of the other. Finally, I will compare the two concepts with respect to their role in explaining statistical correlations. If the criterion of explanatory adequacy is the deducibility of the correlation from a partition satisfying the conditions of the respective definition, then the two notions are explanatory equivalent. However, if one stipulates that a criterion of explanatory relevance should be satisfied, the two theories are inequivalent. Explanatory relevance is discussed in the light of the notion of objectively homogeneous relevant partition, suggested by Salmon in his Statistical-Relevance model of Scientific Explanation (1971): only RHS-RCCS are explanatory relevant partitions with respect to the events in the explanandum correlation.

B3.2 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 11:00–13:00
Main Building, Room 12

Causation and spatial scale

Kelleher Joshua
School of History, Philosophy, Religion & Classics, The University of Queensland, St Lucia, AUSTRALIA

Whether and how causation between levels of organization can take place is an issue for both philosophy and science. In this paper I examine the combining of two approaches to organization and their causal commitments, the classic (hierarchical composition) and the revisionary (scale causation) [Potochnik and McGill (2012)], and argue for a position between them that is shown to be preferable in light of the total commitments required for either. Whereas the standard approach determines causal relationships by first distinguishing levels via compositional hierarchy and then relating the components to get same- or inter-level causation, the revised approach assumes causation from the outset as already taking place between different entities at different spatial scales while rejecting the notion of discrete, ontological levels as operationally deficient.

The problem with the revisionary approach of Potochnik and McGill (2012) is not that it replaces levels with scale (as I will endorse) but rather that it assumes causation at all scales without demonstrating what this is through an appropriate theory. To meet this issue I re-model some prominent causal theories with a scaleorganizational view in mind and show that inter-scale causation is indeed possible, but only on a select few theories (interventionism, counterfactual dependence and nomological subsumption). I also explore the possibility of whether theories of productive causation can be adapted to the scale view and find that these failto be adaptable.

In addition to the preceding, I argue that the replacement of levels with scale does not require a reworking of familiar concepts like emergence, reduction, supervenience and realization.

Nested Hierarchies and the Structure of Ecology

McElhoes David
Philosophy, Arizona State University, Phoenix, USA

The domain of ecology is ubiquitously conceived of as a nested compositional hierarchy consisting of discrete and universal levels of organization: atoms at the bottom level, the biosphere at the top, and everything else of interest to ecologists falling somewhere in between. Because of its ubiquity, this traditional hierarchical framework has faced ample scrutiny. Indeed, a variety of metaphysical objections have recently been raised against it. Potochnik and McGill (2012), for example, argue that this conception of hierarchical organization fails to accommodate basic facts about the decomposition of biological and ecological entities, as well as facts about the realization of biological and ecological properties. And, by attacking the close associations between hierarchy, reduction, supervenience, and the fundamental/derivative distinction, Mariam Thalos (2013) argues that hierarchical metaphysics is philosophically useless. The purpose of my paper is to defend the traditional conception of hierarchical organization within ecology from the aforementioned objections. My strategy is to supplement that conception with a novel and precise understanding of the notion of a nested hierarchy: a notion which, up until now, has only been vaguely characterized and, as a result, has been generally overlooked by critics of hierarchical organization. After outlining a variety of different ways one might characterize nestedness, I argue that the nested ecological hierarchy is most charitably described as follows: (Upward Nesting) Anything o at any level n is also at every level m (where m>n). The upshot of my investigation is that we are left with a clear characterization of the structure of the ecological domain which avoids all of the aforementioned objections; moreover, I argue, my characterization can be generalized to advance other philosophical debates occurring within a hierarchical framework: debates about reductionism, the unity of science, downwards causation, and multi-level mechanistic explanation.

Towards an Account of Scientific Constitution

Harinen Totte
Department of Philosophy, King's College London, London, UNITED KINGDOM

It is a common practice in the special sciences to explain the properties and behaviours of wholes in terms of the properties and behaviours of their parts. For example, that neurons are able to transmit signals is explained by describing the components of neurons that are causally relevant with respect to that phenomenon. Similarly, the racial segregation of cities or the evolution of social institutions can be explained as resulting from the actions of the individuals that make up those entities. Given the prevalence of this type of explanation, it is surprising that there are very few philosophical accounts of the scientific constitution relation: what makes something a part of a whole, as this relation is understood in the special sciences? I will suggest that formal mereology is of no help here and go on to present my own definition of the scientific constitution relation. I will then test how my definition deals with a number of concrete cases.

Scientific Realism, Historical Essences, and Species

Godman Marion
HPS, Cambridge, Cambridge, UNITED KINGDOM

Natural kinds are thought to be an important asset for those who want to defend scientific realism at least in the special science domains (e.g. Kornblith 1991, Boyd 1991; Khalidi 2012). Essential natures are less in vogue. Many scientific realists want to dispense of essentialist requirements for natural kinds, while only a few dissidents maintain that abandoning essential natures might actually undermine scientific realism (Devitt 2005). The key case for the debate is biological species. While a dominant view holds that species might be natural kinds but lack essential natures (e.g. Sober 1980; Dupré 1993), some have argued that species do in fact have historical rather than intrinsic essential natures (Griffiths 1999; Millikan 1999). However replacing intrinsic essences with historical essences might come at a price since historical essences are relational. As such it has been suggested that they fail to do the realist epistemic and ontological work traditionally assigned to intrinsic essences (Okasha 2002; Devitt 2008).

This paper tries to counter this pessimism with respect to historical essences by arguing that they do have the right epistemic and ontological credentials that can underwrite defences of scientific realism. I begin by motivating why natural kinds with essential natures should matter for those wishing to defend a scientific realism. This also leads to specifying two basic jobs for essential natures: one which has to do with providing individuation criteria of kinds and the other for offering causal explanations of projectable properties. This sets the scene for asking: do species have any properties that can perform these roles? I ague that while the intrinsic essentialist strategy falls short with respect to both individuating and causally explaining kinds, the historical essentialist strategy is fit for task. I conclude that historical essential natures of natural kinds like species can support a scientific realism.

B3.3 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Tuesday, August 4 • 11:00–13:00
Main Building, Room 12

Modal Epistemology and Scientific Classifications: Evolutionary Scenarios as Possible Worlds and Bayesian Inference

Martínez-Bautista Elizabeth
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Philosophical studies of modal epistemology have focused on the logical-semantic aspect, where there have been important philosophical contributions but at the cost of leaving aside scientific practice. I consider that studies about modality should focus on how science actually works, particularly on how the notions of "necessity" and "possibility" are used to evaluate actual epistemic scenarios. Studying actual practice would help us to understand correctly the inferential process behind the generation of scientific knowledge. For this reason, in this presentation I examine the case of systematic biological species to show how the inference of evolutionary scenarios and the use of Bayesian reasoning illuminate the use and importance of modal notions in actual practice.

Briefly, modal epistemology aims to explain the link between the beliefs of an individual and what constitutes reliable knowledge. To carry out this objective, modal epistemology evaluates beliefs in actual and possible situations to show that the link between truth and belief is more than a lucky coincidence in the real world. The evaluation involves the use of notions of "necessity" and "possibility" whose value lies in being epistemic devices that help us to establish the conditions of possibility of knowledge in general.

Both in everyday life, as in science, the tendency to use a modal reasoning in planning and decision making is present. But given that science generates reliable knowledge about the natural world, modal reasoning is explicitly expressed in the construction of experiments that verify a hypothesis as well as in the exploration of possible explanatory and predictive inferences derived from scientific practices, exemplified, in this presentation, by the field of systematics.

Systematics is a discipline of biology that aims to classify discrete entities of nature in evolutionary units called species. To obtain natural classifications, it evaluates counterfactual evolutionary scenarios, called hypothesis of phylogeny, which have a degree of probability of being true given available evidence. Evaluating evolutionary scenarios involves a kind of modal reasoning that is exemplified by Bayesian inferences which support hypotheses of kinship between species and higher taxa. Bayesian reasoning, being an instance of modal reasoning, allows us to affirm the reliability of phylogenetic hypotheses in obtaining an explanatory and predictive knowledge about the evolution of biological species and the diverse forms of life in nature.

I consider that an approach to scientific practices, plus developments in logic and semantics, will give us a better understanding on how scientific inferences are obtained and how reliable knowledge is generated. Given that studying modal epistemology in the context of scientific practices has been poorly developed in philosophy, my work is a contribution to this field as well as a contribution towards better understanding scientific reasoning.

Counterfactuals, Observability, and Modal Metaphysics: a response to Ladyman

Gallegos Sergio
Philosophy, MSU Denver, Denver, CO, USA

van Fraassen has been criticized for allegedly doing the same thing that he objects in others: to accept certain controversial metaphysical theses. For instance, Ladyman (2000) argues that van Fraassen's constructive empiricism leads him to adopt a version of modal realism. In particular, Ladyman has contended that, though constructive empiricism is committed to the view that counterfactual conditionals have no objective truth-value, van Fraassen's notion of observability and his acceptance that statements such as 'X is observable' have objective truth values lead to the conclusion that some counterfactual conditionals have an objective truth value (which is a form of modal realism). In response to Ladyman, Monton and van Fraassen (2003) argue that, though observability is often understood in terms of counterfactuals and in general counterfactual have no objective truth conditions, observability is not a modal property, which entails that there are objective, non- modal facts about what is observable. In particular, they claim that what is observable follows from some generalities about actual facts. Ladyman (2004,

762) has countered that, where X is never actually observed, such generalizations are insufficient to determine what would happen if X was present unless we accept that 'the specification by science of some regularities (...) as laws (...) is no merely a matter of pragmatics, but is latching on objective features of the world.' My goal in this paper is to provide a response to Ladyman along the following lines: after arguing that van Fraassen's project is best considered as a form of descriptive metaphysics, I will show that van Fraassen can respond that being committed to 'X is observable' having an objective truth value requires having the concept of an objective order of things with regularities, but this does not entail that the regularities in question latch on features of the world.

Grounds and Structures. A Discussion on a Possible Metaphysical Framework

Savu Bianca
Theoretical Philosophy and Logic, University of Bucharest, Faculty of Philosophy, Bucharest, ROMANIA

One of the goals structural realists aim to achieve is providing a metaphysical framework for this view, complementary to the epistemic one Worrall proposed since 1989. In this sense, ontic structural realism (OSR) seems to be a very promising option, committed to the idea that the world has an objective modal structure, which is pictured by the mathematical structure of our best scientific theories. Our modal claims have their truth-value, according to this, independently of our epistemic states. A critique due to Stathis Psillos starts developing from the observation that modality cannot be drawn from the mathematical structure, as if there is such a structure, the claims involved are necessary, by definition. His proposal is to have an account which is abstract enough that it would ensure independence of any physical system, but also instantiated by concrete physical systems, and this would be possible, in his view, if one includes a form of Causal Structuralism on the list. Our proposal is to take into account Kit Fine's theory on Grounding. Fine advocates that the discussion of what is real, or fundamental, should start from discussing grounds, which are to be considered the form of metaphysical essence, and this observation is useful in approaching Psillos' proposal. The novelty Fine brought on essentialism is that necessity is no longer the primitive notion, but reducible to essence. A form of expressing essence is, for now, that an object P has a property A in virtue of the class of objects that have that property, and the most important achievement is ontological independence, which seems to be what Psillos is looking for. We explore the benefits and risks of accommodating ground and structural realism, and question about the means this would be possible, taking into account truthmakers and/ or hybrid logics.

Antique atomism, modern physics and structural realism

Mamchur Elena
Philosophical Issues in Natural Science, Institute of Philosophy RAS, Moscow, RUSSIAN FEDERATION

The article deals with the status of Plato's version of antique atomism in contemporary science. It has been shown (W.Heisenberg) that mathematical atomism by Plato in many respects anticipated the ideas of atomism of modern physics. The author connects mathematical atomism with the structural realism which is now considered by many philosophers of science as the most defensible form of scientific realism (J.Ladyman). The conception of structural realism has made it possible to undermine the argument of "pessimistic induction" and to bring a significant contribution into rational reconstruction of the process of theory-change. It is supposed in the article that the establishing the connection between structural realism and Plato's atomism makes it possible to take out the latter from the sphere of natural philosophy and to place it into the frames of rational discussion about the structure of being.

B3.4 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Thursday, August 6 • 11:00–13:00
Main Building, Room 8

Against Structural and Counterfactual Explanations of Highly-Idealized Models in Physics

King Martin
Philosophy, University of Guelph, Guelph, CANADA

Much of the recent literature on explanation has aimed to expand the scope of philosophical accounts of explanation to reflect the scope of the explanatory practices of science. Alisa Bokulich has developed a structural account of explanation that she claims is capable of correctly judging certain highly-idealized, or non- representing, models as explanatory. These models either fall outside the range of other accounts of explanation or are deemed non-explanatory. However, they are considered explanatory by some philosophers and physicists. Bokulich argues that this is in part because even though they do not accurately represent the target system they are able to capture its structure in providing reliable counterfactual information in terms of w-questions. Models of semiclassical mechanics are of particular interest to Bokulich because the dependency relations between the classical trajectories and the quantum systems cannot be construed as causal. In this paper, I examine a worry that once the account of structural model explanations allows for such fictions as classical electron trajectories in quantum systems, it will be unable to reject models that are widely considered non-explanatory, such as the models of Ptolemaic astronomy. In order to evaluate this concern, I look at two reasonable approaches to measuring or assessing a model's structural information in terms of counterfactuals. I argue that neither approach is ultimately satisfactory. The simplest approach of just measuring structure as the number of w-questions proves impossible, and the comparative approach, while succeeding in debarring the Ptolemaic explanation, fails to find the semiclassical model explanatory. If neither approach is capable of identifying the semiclassical model as explanatory, then, I argue, the measure of structural similarity that a highly-idealized model bears to its target system is largely irrelevant to its being explanatory.

Do we need an explanation of regularities?

Felline Laura
Philosophy, Universita' roma 3, Rome, ITALY

Two time-honoured philosophical currents, Necessitarianism and Regularism, traditionally stand opposite in their understanding of the existence of regularities. According to Necessitarianists the existence of an order in the Universe calls for an explanation. Without such an explanation, the existence of regularities would be an unacceptably improbable 'cosmic coincidence'. Regularists respond that physical necessity is actually explanatorily useless and has no role in science. We must therefore bite the bullet and embrace the ultimately inexplicability of the order in the Universe.

In contrast with such views, in this talk I argue that the existence of order in the Universe does not require an explanation. Moreover, an explanation of such kind would be alien to the scope and the means of a scientifically informed metaphysics. First of all, in order to claim that P requires an explanation, without which P would remain an 'unexplainable mystery', P must create a tension in our representation of the world. This might be either because P is incoherent with some other element of such representation, or even just because we have some reasons to expect non-P to be true, rather than P. I argue that none of the above is the case for regularities. Once both the charge of inconsistency and that of counter-intuitiveness are ruled out, insisting on the requirement for an explanation of regularities in terms of a metaphysical underpinning is as pertinent to the scope of metaphysics of science as questions like: "why is there change?" or "why is there something rather than nothing?". Secondly, there is a more epistemically driven consideration that suggests that regularities do not require an explanation within a metaphysics of science. I argue that, in real scientific practice, the assumption that similar systems behave in the same way plays the role of an a priori assumption for theoretical research and cannot therefore undergo a metaphysical explanation.

Scientific Understanding and Explanatory Interest

Zhu Xu
Philosophy, University of Chinese Academy of Sciences, Beijing, CHINA

Understanding has been already attracting many debates in epistemology. Kvanvig (2003) claims that understanding, like knowledge, is factive. However, several commentators have argued that understanding, especially the scientific one, is often not factive. For example, idealization or simplification can provide understanding for scientists even it is not true in a strict sense (Elgin 2009). Kvanvig only preserves understanding when the falsehoods are peripheral. But understanding seems also probably arise even false beliefs are not peripheral but central (Riggs 2009).

The aim of this paper is to show the thing that really matters here is a distinction between reactive and objective attitudes in ascription of understanding. That notion is elaborated from Peter Strawson's original idea in a totally different context. In his opinion, only in a reactive attitude, can we see each other as a fully responsible agent; and here also as a full agent with epistemic responsibility.

A reactive attitude in ascribing understanding implies explaining with specific interests. Contrastive explanation has emphasized a kind of interests. Explainer needs, at least potentially, an answer for a significant question in his own view: 'Why is it P rather than Q?' Factivity characterizes another kind of explanatory interest. To explain something in a reactive attitude involves a commitment for significance of corresponding contrastive questions, and factive commitments for both explanandum and explanans. On the contrary, ascribing understanding to someone in an objective attitude would deny or remain indifference on those commitments, such as cases of understanding arising from false theories in history of science.

Therefore, understanding in a reactive attitude does satisfy factivity requirement, which is factivity qua explanatory interest, rather than itself. And understanding without factivity could also be ascribed in scientific practice, not just in an honorific use as Kvanvig claims, but in an objective attitude.

On Characterizing Relevance

Rusanen Anna-Mari
Philosophy, history, culture and art studies, University of Helsinki, Helsinki, FINLAND

Relevance is one of the most fundamental concepts in philosophy and in philosophy of science in particular. For instance, it is often proposed that explanatory models describe accurately "the relevant factors" and leave out the irrelevant ones. Also, in many current accounts of scientific representations, it is often assumed that scientific models can represent their targets, if the representational relationships are based on "relevant" similarities, resemblances, isomorphisms (or other morphisms) between models and their targets.

However, there is remarkably little discussion on how to define relevance in the philosophy of science, and in current literature on modeling in particular. It is slightly surprising, because as a concept "relevance" is far from trivial. On the contrary, it has been notoriously difficult to characterize it in a satisfactory way. For example, most of the classical accounts on explanations, such as Hempel's deductive-nomological model or Salmon's causal account of explanation have struggled with the satisfactory notion of relevance. In addition, relevance still raises puzzles for most, if not all, current accounts of explanation (Hitchcock 1995; Imbert 2013).

In what follows, my focus is on the question, how to define the notion of relevance. In the first part of this paper, I will sketch a general characterization for the notion of relevance. However, depending on the specific context, the interpretation of relevance varies. In the second part of this talk my goal is to articulate some of the ways that the notion of relevance has been understood in various scientific domains. In the final part of this paper I will focus on the "fundamental" question: Is relevance something that an item or an entity "has", or is something that is ascribed to items and entities by intentional agents for some purposes or goals?

B3.5 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Thursday, August 6 • 14:30–16:30

Main Building, Room 6

Scientific Fundamentalism CANCELLED

Kutach Douglas

Language, Linguistics, and Philosophy, University of the West Indes, Mona, Kingston, JAMAICA

Scientific realism, as usually conceived, is a poorly designed doctrine, largely because realism is a poorly designed concept. There are several well-known deficiencies in the concept `reality' that make it suboptimal for investigating metaphysics and its relation to science. For example, to speak of `what is real' or `what exists' tends to conflate semantic issues, like meaning and reference, with the non-linguistic issue of ontology. Fortunately, a new conceptual tool is now on the market: `fundamental reality'. Recent work on fundamentality has revealed important advantages to be gained by replacing our traditional concern for `what is real' with concern for `what is fundamental'. In this talk, I will demonstrate how to reformulate scientific realism in terms of fundamental reality. The resulting thesis---scientific fundamentalism---is a more easily defended position than scientific realism and better satisfies the standard motivations for scientific realism. More important, its content is clearer. In order to stay within the talk's time limit, my presentation will be limited to three tasks. First, I will specify what I think is the best way to make precise the meaning of `fundamental reality'. I accomplish this by drawing a binary distinction between fundamental and derivative reality without the more contentious use of a ``more fundamental than" relation, or grounding relations, or levels of reality. The other component is that our ideal guess at fundamental reality is a model that best accounts for the totality of empirical data. (2) I will demonstrate how scientific fundamentalism helps to circumvent two standard criticisms of scientific realism, namely the underdetermination of a theory by the evidence and our apparent lack of a sensible notion of verisimilitude. Third, I will cite further benefits of scientific fundamentalism that could in principle be spelled out in more detail.

Naturalness of physical theories and fundamentality of laws

Filomeno Aldo

Philosophy, UAB (previously), Barcelona, SPAIN

This talk reflects upon which requirements, if any, should be met by a theory to be considered as fundamental. Some traditional criteria for fundamentality, naturalness and simplicity, are shown to be inconsistent with certain aspects of our best physics. The argument rests on features of local gauge symmetries that constitute the core of the Standard Model and, crucially, of its candidate successors. It concludes that local gauge symmetries, in spite of their elegance and unificatory power, are non-natural, complex, and far from anything like a priori "super-principles", as firstly proposed by Wigner. Then, the talk assesses how this

conclusion bears on the metaphysics of fundamentality. On the one hand, criteria of naturalness and simplicity ought to be abandoned if the fundamental level is structurally similar to our best physics.

On the other hand, if no assumption is made about the fundamental level, an alternative metaphysical picture gains plausibility alongside the existing ones, one that would better preserve the criteria of naturalness and simplicity. This alternative is that which takes laws not as fundamental but emergent from an underlying level. This fundamental level lacks laws understood as a finite set of governing rules. It is then entertained what could be said about this fundamental level and how could laws emerge.

A behavioral analysis of group knowledge and group behavior

Parikh Rohit

CS, Math, Philosophy, CUNY, New York, NY, USA

Starting with Ramsey, de Finetti and Savage, an analysis of subjective probabilities and utilities was carried out based on an agent's (potential) behavior. If a subject acted according to Savage's axioms then the subject could be seen as maximizing expected utilities.

There were some difficulties with this picture, pointed out by Allais, Ellsberg, Kahneman and Tversky, and others. But the picture does often work and is of value.

What about the many agent case? How can we know what A knows about B's knowledge? There is some intuition present already, as for example in the work of Wimmer and Perner, or the work of Premack and Woodruff. When we ask if an agent has Theory of Mind we ask whether an agent's behavior shows awareness of another's knowledge. Perhaps, if we are lucky, we can even ask for a test of whether common knowledge exists and can be exhibited behaviorally.

We will refer to work by people like Clark and Marshall, Parikh, Pinker, and Verbrugge which addresses such questions and offer a formal theory.

We will also offer suggestions on the thorny issue of "Do collectives exist as real agents?"

Summarizing the Quantum World: The Universal Wave Function as a Humean Law

Keming Chen Eddy

Philosophy, Rutgers University, New Brunswick, USA

In this paper, I examine the apparent conflict (as noted by Tim Maudlin (2007), among others) between the metaphysical thesis of Humean Supervenience and the empirical observations of quantum entanglement. The conflict results from the separability thesis in the former and the holism in the latter.

To resolve the conflict and to defend Humean Supervenience, I propose a solution by taking the entanglement relation into the wave function and then taking the wave function as a Humean law that summarizes the facts about the mosaic. This solution is inspired by Ned Hall (2009) and is similar to the proposal by Elizabeth Miller (2013), Michael Esfeld (2014), and Craig Callendar (2014). However, there seem to be fatal objections to their proposals because of the character of the wave function. To be a Humean law, the wave function must be part of the "best system" that balances simplicity, informativeness, and uniqueness. Although the wave function seems to fail on all these criteria—it seems complicated, unwieldy, and underdetermined by the particle trajectories, I suggest (against such appearances) new mathematical reasons from the quantum dynamics to think otherwise. First, I show that the appearance of great complexity in the wave function is due to the mistaken equivalence between informational complexity and representational complexity. Second, I use the Bohmian effective wave function as an example to show how the universal wave function, though impossible to calculate exactly, is informative and useful in practice. Third, I suggest that the wave function is unique up to a satisfactory equivalence class, by constructing a light-cone structure in the configuration space and giving a geometrical plausibility proof for a restricted version of the uniqueness claim, which allows the Humean best system to support ordinary counterfactuals. Therefore, taking the wave function as a Humean law is an available and attractive defense of the thesis of Humean Supervenience.

B3.6 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Friday, August 7 • 17:00–19:00
Main Building, Room 12

Ontic Structural Realism and Natural Necessity

Kallfelz William
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J. Ladyman (1998-2009), Ladyman and Ross (2007) refine J. Worral's (1998) structural realism (SR), by developing an ontic structural realism (OSR) which they argue is a consistently naturalistic means of characterizing the ontology of fundamental physics. I argue that particular elements of M. Lange (2009) and M. Eklund (2006) strengthen and refine their project of characterizing fundamental physics via OSR and by extension, their presentation of information-theoretic structural realism (ITSR). I demonstrate this point by situating M. Lange's (2009) discussion of nomological modality and natural necessity within Ladyman and Ross's discussion of ITSR. The logical hierarchy evinced in Lange's (2009) notion of 'nomic stability' further refines Ladyman and Ross's claims through the addition of nuanced modal distinctions in a systematic framework. Moreover, I argue that what Lange considers are the 'lawmakers' (viz. subjunctive facts) serve as a *de dicto* rendition of some of Ladyman & Ross's fundamental *de re* extensions and refinements of 'real patterns' (Dennett, 2001).

References: Dennett, D. (1991). Real Patterns. Journal of Philosophy, 88, 27-51. Eklund, M. (2006). Metaontology. Philosophy Compass, 1/3, 317-334. Ladyman, J. (1998). What is Structural Realism? Studies in History and Philosophy of Science, 29, n. 3, 409-24. (2008). Structural Realism and the Relationship between the Special Sciences and Physics, Philosophy of Science, 75, 744-55. (2009). Structural Realism. *The Stanford Encyclopedia of Philosophy (Summer 2009 Edition),* E. Zalta (ed.), <plato.stanford.edu/archives/sum2009/entries/structural-realism/> Ladyman, J. and Ross, D. (2007). Every Thing Must Go: Metaphysics Naturalized. (Oxford: Oxford University Press). Lange, M. (2009). Laws & lawmakers: Science, Metaphysics, and the Laws of Nature. (Oxford: Oxford University Press). Worrall, J. (1989). Structural realism: The best of both worlds?, Dialectica, 43, 99–124. (Rep. in D. Papineau, (Ed.),The Philosophy of Science (pp. 139-165) Oxford: Oxford University Press.)

Scientific Structuralism Does Not Necessitate Modal Realism

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Pättiniemi Ilkka
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In this paper we argue that the Modal Realism espoused by James Ladyman and Don Ross in their book Every Thing Must Go (2007, OUP: Oxford) is in conflict with the critical aspect of their program of naturalistic metaphysics. Ladyman and Ross criticize traditional metaphysics done without empirical constraints – what they call strong metaphysics. They contrast strong metaphysics with weak metaphysics based on Kitcherian unification. The metaphysical position Ladyman and Ross embrace is Ontic Structural Realism, wherein the structure is taken to be the objective modal structure of the world. In their (2007) and in various works by Ladyman a battery of arguments for Modal Realism is given. However, we argue that Modal Realism is not supported sufficiently by the special sciences or fundamental physics and that it does not do the unificatory work they claim is the only acceptable form of metaphysics. In addition, the motivation for Modal Realism seems to be similar to the motivation that traditional metaphysicians have for their strong metaphysical theses – that is explaining something psychologically mysterious or miraculous. Thus we claim that Ladyman and Ross face the following dilemma: either they have to (1) accept that they participate in strong metaphysics, or (2) dilute their Modal Realism to the point that it is indistinguishable from certain forms of antirealism. One additional justification that Ladyman and Ross give for Modal Realism rests on the fact that modal claims are indispensable in science. This might be true, but it is not sufficient to show that the world as such has an objective modal structure. We will outline an empirically equivalent interpretation of modal claims based on the works of V.W. Quine, James Woodward, Huw Price, Robert Brandom, and Jaakko Kuorikoski.

Structural Realism without Metaphysics; Notes on Carnap's reinvention of Ramsey-sentence approach

Davoody Beni Majid
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Carnap's reinvention of the Ramsey-sentence approach to scientific theories has been at the centre of a new debate in recent years. The credit of bringing back the subject to the foreground goes to Stathis Psillos (2000). Following Grover Maxwell, Psillos (2000a) argued that Carnap's re-invention of the Ramsey-sentence had failed to end in the desired neutral stance in the realism-instrumentalism debate, and led, instead, to a form of structural realism, which happened to be liable to Newman's objection to Russell's version of structural realism.

Friedman opposed Psillos by saying that Carnap's mature conception of a scientific theory as the conjunction of its Ramsey-sentence and Carnap-sentence had indeed paved the way to the anticipated neutral position (Friedman 2009). Consequently, Friedman claimed that Newman's objection, raised in the context of the recent debates about the structural realism, is no problem for Carnap's conception of Ramsey-sentence approach (Friedman 2009).

My aim is to show that Carnap's reinvention of Ramsey-sentence approach to theories led to a singular and unorthodox form of structural realism, which is based on the practical methodological considerations, operating at the basic level of the construction (or choice of the rules) of the linguistic systems. To put the argument in a nutshell, it could be shown that the stance is an elaborated extension of realism, because, Friedman's objection notwithstanding, a robust factual referential link can be established between the variables of Carnap's structure and the facts of the matter. Interestingly, due to the non-semantical nature of the practical considerations which are restraining Carnap's pragmatic form of structural realism, this realist stance is not at odds with the metaphysical neutralism which Friedman has duly underlined in his representation of the Carnapian position.

An essentialist interpretation of Ontic Structural Realism

Bigaj Tomasz
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The key thesis of the non-eliminative variant of Ontic Structural Realism is the Dependence Claim: objects are ontically dependent on the relational structures they participate in. The relation of ontic dependence in turn is usually explicated in terms of determining (grounding) facts of the numerical identity and distinctness of individual objects. That is, structural realists typically claim that relational facts ground facts regarding the numerical diversity of the relata. In my paper I propose to reinterpret the Dependence Claim in terms of the determination of counterfactual identity. More specifically, I suggest that ontic structuralists should shift their attention from the problem of how to account for distinctness among the elements of a given structure to the issue of how to identify these elements in various counterfactual situations. A structuralist answer to the latter problem should consist in an identification, for any object x, of a particular structure S(x) containing x and such that in a counterfactual scenario (in a possible world) a possible object x' represents de re the actual object x iff x' participates in a structure S'(x') isomorphic with S(x), with x' being an image of x in an appropriate isomorphism. The structure S(x) can be called essential, since participating in it is an essential property of x (i.e. a property such that without it an object would lose its identity). I will further argue that this essentialist form of ontic structuralism can receive substantial support from fundamental physical theories. For instance, the metrical structure of spacetime points can arguably be seen as constituting their essence. It can be also claimed that the fundamental state-independent properties of elementary particles determine their counterfactual identity while being structural in character, as they can be interpreted using group-theoretical concepts related to the underlying symmetries.

B3.7 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Friday, August 7 • 14:30–16:30
Main Building, Room 12

The Multi-Storey Humean Mosaic and the Emergence of Objective Probability

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David Lewis provides an account of physical law which avoids appeal to modal notions. This account is based on systematising the regularities found in the Humean mosaic (set of events associated to all space-time points). It thus lends itself to a reductive picture of the physical world. I will argue, however, that we have good reason to believe that there are facts about composite objects (e.g. biological facts) which cannot be straightforwardly reduced to facts about fundamental physics, chiefly due to the multiple realisability thesis. As such, the Lewisian analysis of law needs revision.

I will suggest that acknowledgement of these higher level facts (where the lowest level describes fundamental physics) should lead us to posit a multi-level Humean mosaic and carry out the Lewisian analysis distinctly at each level. This will lead to the conclusion that there are more laws than we might previously have expected. In particular there may be laws which directly entail facts about artefact regularities at the higher levels.

At this point, I will turn to probability. The insights gleaned thus far will be relevant to the literature debate surrounding deterministic chance. Distinct laws at various levels implies the compatibility of fundamental determinism with higher level objective probabilities. Following Glynn (2010) I will argue that these probability assignations can satisfy Schaffer's platitudes about chance (Schaffer 2007). Drawing distinctions between the levels allows for a unified view of physical law and probability which invokes minimal metaphysics.

Randomness and coincidences: a strong overlap between them

Melas Alessandra
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It is a widespread view that to say something happens by chance is near enough to say it happens randomly. Even though this idea – an idea we find in ordinary usage and in scientific usage as well – is quite misleading, there seems to be a kind of overlap between at least some notion of chance and randomness. Investigations along this line will be the object of the present work. More precisely, the present survey takes in consideration chance intended as "coincidences" – where coincidences are chance events that come from the concurrence between independent causal chains – and its relation with randomness.

As well known, in a series of similar accidents, there is a complicated and unpredictable variation of fluctuation in the details of the various accidents, and the events of interest fluctuate in a way they seem to have a variation which is usually called "random". But which is the origin of this random variation? According to David Bohm and Walther Schützer (1955) a proper criterion for randomness is the statistical independence between all of the causal factors involved in the production of the accidents.

Starting from this criterion, I will show that there seems to be a kind of strong overlap between the coincidental notion of chance and the notion of randomness. First of all, I will illustrate that both notions, the notion of randomness and the coincidental notion of chance, need to be understood in terms of the independence of the causal factors involved. Secondly, and probably most importantly, I will point out that randomness may come from a series of similar coincidental events, and then that the independence of the intersecting causal processes which originate the accidents (coincidences) is also the origin of the random variations.

Intelligent Design, Methodological Naturalism and Scientific Reasoning

Loikkanen Juuso
School of Theology, University of Eastern Finland, Joensuu, FINLAND

Today, one of the most controversial phenomena in the philosophy of religion is the theory of intelligent design (ID). According to ID, chance, necessity and design are the three mutually exclusive and exhaustive modes of explanation of all events. Proponents of ID maintain that certain features of the universe are too improbable to have come about merely by natural causes, i.e., chance and necessity, and are thus best explained by an intelligent supernatural cause. Consequently, they claim that since methodological naturalism, which only accepts natural causes, is incapable of explaining design, it must be abandoned as a basis for science and be replaced by ID. I argue, contrary to ID, that chance, necessity and design are not mutually exclusive, and that we do not need to set natural causes and (possible) divine design against each other. Furthermore, I claim that, since ID does not make any testable predictions whatsoever, methodological naturalism continues to provide the only reliable basis for doing empirical science. I maintain, however, that ID's argument against methodological naturalism could be refined in a way that would – in theory – require methodological naturalism to be complemented with further explanations.

Against a monistic view of information – Information in biological and physical contexts

López Cristian Ariel
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Ferreira Ruiz María José
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At present, information is everywhere. In its everyday sense, the concept of information involves semantic and epistemic notions, such as meaning, representation and knowledge. In a technical sense, the concept is related with notions as probability, statistical correlations and algorithmic complexity. In the last half century, the scientific discourse has been permeated by an informational language that is becoming increasingly extended and fundamental. For instance, in biological sciences, the term 'information' was introduced to describe the production of proteins from genes, and has been since then a key concept in the field of molecular biology, giving rise to the familiar expression of genetic information. The concept of information has also spread into many other subdisciplines, such as ecology, cell biology, behavioral biology and evolutionary biology. In turn, the notion of information has become also central in physical sciences. In particular, quantum information promises to alter dramatically the field of communication. Moreover, it is argued that quantum mechanics itself may be entirely reconstructed in an informational language. Be that as it may, the concept of information is here to stay in the scientific discourse.

But, what is information? The philosophical discussion on the matter has been focused on the search for a single answer to the question, as if 'information' had a univocal meaning, regardless of the scientific and epistemic context. This fact has led to a generalized monistic view about the nature of information. We think that this is a misguided starting point. Our aim in this presentation is to argue that the nature of information is contextdependent and definable by the rules of each scientific field. Our position leads to a pluralistic view about information that, despite giving up a unified concept, it becomes more accurate as well as more useful in the scientific practice.

B3.8 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Saturday, August 8 • 10:00–12:00
Main Building, Room 12

Pragmatic realism and truth as correspondence

Määttänen Pentti
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

Realism holds that we can have true knowledge about the mind-independent real world. According to classical (or semantical) truth theory, truth is correspondence between statements and the world. The relation between statements and the world is semantical. It is often said that the relation must be non-epistemic because our epistemic relation to the world depends on internal conditions and is thus mind-dependent. However, what mind-independence means, depends on what one means with mind. If we accept that mind is embodied, then we face the question of what these internal conditions ultimately are. Is embodied mind independent of the physical properties of instruments of our epistemic access to the world, that is, bodily sense organs and external instruments? These physical properties have an effect on how the world is observed with these instruments. On the other hand they are internal conditions in the sense that they are properties of the knowing subject and the instruments used. The relation between statements and instrumentally accessed things is epistemic because instrumental access is (thick) epistemic access. The truth-relation between statements and instrumentally accessed things is epistemic, but can be analysed in terms of correspondence. Tarski's Tschema can be applied. The fit between statements and the world is operational. Observations are operations with bodily or external instruments. Epistemic truth is often seen as a sign of antirealism. However, bodily organs and external instruments are as real and objective elements of the universe as their counterparts of interaction. The physical viewpoint determined by these instruments does not corrupt objectivity in the same sense as conceptual viewpoint. And there is no reason to deny the existence of things beyond the scope of present instrumental access, but can be objects of knowledge only until they have become within the reach of instrumental access.

Alethic Pluralism and Scientific Truth

Marletta Marco
Humanities, University of Palermo, Palermo, ITALY

Recently Ian Hacking has argued that the correspondence theory of truth is not satisfactory to explain the concept of scientific truth and that we should endorse a pluralist theory of truth within the scientific domain, claiming that the number of scientific truth properties is greater than one (Hacking 2012). But he does not articulate this insight in depth and therefore, the aim of my paper is to bridge this gap in the literature concerning the relation between theories of truth and science. The thesis that I will discuss states that, just like standard alethic pluralism claims that there are as many truth properties as there are fields of discourse (empirical, moral, legal, mathematical...), scientific alethic pluralism (SAP) claims that there are as many truth properties as there are styles of scientific reasoning (mathematical, experimental, probabilistic, analogical...). Since this is still vague, I will distinguish three kinds of (SAP): (1) method-dependent (alethic pluralism follows from methodological pluralism); (2) discourse-dependent (alethic pluralism follows from the plurality of styles of reasoning); (3) language-dependent (alethic pluralism follows from the impossibility to define a languageindependent truth predicate). I will conclude that both (1) and (2) are not tenable because they collapse into epistemological pluralism (without any metaphysical implication). On the contrary, (3) is tenable if based on Tarski's idea that we can define the truth predicate only referring to a given fragment of language L, but is very different from Hacking's original claim because: a) the divisions of scientific language do not depend on the styles of reasoning, but, rather, on the stability of meaning in the sub-sets of L; b) the existence of more than one truth property is not required and replaced by a plurality of truth predicates, which is entirely consistent with the correspondence theory of truth.

Does Hacking get the most out of his microscopes?

Aylward Alexander
History and Philosophy of Science, University of Cambridge, Cambridge, UNITED KINGDOM

Ian Hacking once asked, 'Do we see through a microscope?'. In building his discussion (1983; chapter 11) around such a question, Hacking places himself within the complex debates surrounding the nature of observation, vision, and images. He also believes that he has distanced himself from the 'metaphysical debates' about realism, with his arguments only bearing on the practical questions that surround distinguishing objects from mere 'artifacts' of the microscope (202). In this paper, I question Hacking's approach to his discussion of microscopes. As Hacking realizes, concluding that we in fact do 'see' through a microscope is no positive argument for realism about the entities in question, as doing so merely betrays one's pre-existing realist loyalties (208). I examine a means by which Hacking can get a lot more from his microscopes. In this approach, Hacking would be required to adopt the approach of Nancy Cartwright (1983) in advocating entity realism via inference to the most probable cause (IPC), but his discussions elsewhere of 'experimental' realism give us reason to believe that he should not object to such a move. I argue that Hacking erects a false dichotomy with microscopic work on one side and experimental work concerning 'unobservables' on the other. In opposition, I suggest that we simply see microscopes as sophisticated apparatus for detecting effects of causal phenomena, that happen to organize their collected data into cognitively pleasing representations. Seen as such, microscopes are not fundamentally different from the kind of apparatus discussed by Hacking in the context of his 'experimental' realism concerning entities that he believes to be unobservable in principle (1983, 262). Through adopting the suggested approach, Hacking would sidestep the minefield surrounding questions of vision and observation, whilst positioning himself to provide strong arguments for the kind of entity realism he elsewhere endorses.

Indeterminacy and Inequivalence

Toader Iulian
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The standard realist move against the claim that no scientific theory can secure determinacy of reference is to embrace structuralism and argue that indeterminacy of reference does not imply indeterminacy of truth conditions. To show that determinacy of truth conditions can be secured, one typically insists on empirical or computational constraints that might eliminate the "unintended" interpretations that make a theory true. Idealization procedures in scientific practice indicate, however, that such interpretations are necessary to account for a range of natural phenomena. In my paper, I discuss the implications of this fact for semantics and modal ontology.

In particular, after providing some background on classic indeterminacy arguments, I describe the problem raised by unitary inequivalence relations in quantum theories, a problem caused by the failure of the Stone-von Neumann theorem in idealized systems, e.g., in systems with an infinite number of degrees of freedom. Then I argue that this is not a problem with determinacy of reference (and if it is, then it can be easily solved by relativizing reference), but rather a problem with determinacy of truth conditions. I point out that insisting, as many do, on physical constraints that could restore determinacy of truth conditions cripples the quantum theory by making it unable to account, e.g., for the mass of massive elementary particles. Then I argue that a recent attempt to accommodate indeterminacy of truth conditions, by considering the "unintended" interpretations of the theory as possible worlds, commits the realist to a possibilist modal ontology. I end by defending a naturalist view to the effect that one's modal ontology should stem from one's scientific practice, rather then being derived from folk theories and then imposed on this practice.

B3.9 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Saturday, August 8 • 13:30–15:30

Main Building, Room 12

How to be a Historically Motivated Scientific Anti-Realist

Frost-Arnold Greg

Philosophy, Hobart and William Smith Colleges, Geneva, USA

Suppose one believes that the historical record of discarded scientific theories is good evidence against scientific realism. Should one adopt Kyle Stanford's specific version of anti-realism, based on the Problem of Unconceived Alternatives (PUA)? This talk first presents reasons for answering this question in the negative, and then describes another version of historically motivated anti-realism that enjoys the virtues of Stanford's account, without its shortcomings.

The primary problem with Stanford's PUA-based argument is that it cannot use many of the prima facie strongest pieces of historical evidence against realism, namely (i) superseded theories whose successors were explicitly conceived, and (ii) superseded theories that were not the product of elimination-of-alternatives inferences. Examples of (i) include Ptolemy considering the hypotheses that the Earth moves on its axis and from place to place. One example of (ii) is the hypothesis that electrical resistivity is proportional to temperature cubed, prior to the discovery of superconductivity.

Stanford claims his PUA-based argument against realism is superior to the old-fashioned pessimistic induction (PI) because the PUA provides a reason why historical theories were wrong, when they were wrong. The PI is merely an enumerative induction, without providing any explanation of why past theories failed (which threatens the PI, because past and present theories are dissimilar—and without this explanation, we cannot determine whether these dissimilarities undermine the inductive inference). Thus I defend an alternative explanation of failed past theories, which supplements the PI: the reason past scientists accepted theories that are not approximately true was because the total body of evidence available at that time was unrepresentative or otherwise misleading. Ptolemy was rational to claim the Earth is stationary, because he observed no stellar parallax. And physicists in 1900 were rational to claim electrical resistivity was proportional to temperature cubed, because they lacked any evidence to the contrary.

The Scientific Realism Debate in the Year 2015: A New Era of Realist Criteria and Non-Realist Historical Challenges.

Lyons Timothy

Philosophy, Indiana University-Purdue University Indianapolis, Indianapolis, IN, USA

(I) The scientific realism debate has now reached an entirely new level of sophistication. Faced with increasingly focused challenges, realists have appropriately revised their basic meta-hypothesis that successful scientific theories are approximately true: in the last few years, realists have emphasized criteria that render contemporary realism far more selective, and hence more plausible, than it has previously been. (II) Mindful of these pivotal advances, I articulate a set of conditions that must be met for a selective realist criterion to be viable. I contend that it must be (a) relevant: to explain success, it must pick out constituents that are genuinely responsible, and so deserving of credit, for success; (b) ascertainable: to have any content at all, i.e., to inform us of what we can justifiably believe (and avoid the charge of 'ad hocery'), it must allow identification of just which theoretical constituents qualify; (c) sufficiently realist: to go beyond anti-realism, it must pick out constituents that reach to a level deeper than the empirical data. (III) With these conditions in hand, I consider a set of realist criteria recently on offer. After briefly flagging some that fail to meet the above requirements, I nonetheless point to a set of selective realist criteria that live up to them. With the latter identified, however, I turn to survey a number of cases studies—from 20th century science—advanced as challenges to realism, and I offer a novel account of the nature of the historical threat to realism. I contend that the form and content of this novel challenge severely threaten even a fallible, conjectural variant of epistemic realism. (IV) I conclude on an positive note, however, arguing that scientific realism need not be rejected outright, that a number of its central realist tenets can be retained unproblematically even in the face of such epistemic threats.

Science's Success. An Argumentative Analysis

Repolschi Octavian

Philosophy and Communication Sciences, West University of Timişoara, Timişoara, ROMANIA

The paper presents an argumentative analysis of science's success in the classical realism-antirealism debate in philosophy of science. In the first place, the frame of the problem is stated, placing the argument in the general context of the realism-antirealism debate. Secondly, the success of science is specified according to Putnam's classic formulation (1975), and the meaning of the term "success" is furthermore analyzed according to the concepts of "explanation" and "prediction" proposed in the domain. Then the initial argument is rewritten accordingly, by substituting science's success for it's capacity to explain and predict. Furthermore some problems concerning explanation, prediction and inference to the best explanation are brought into attention, and also their connection to various controversial philosophical aspects involved in the scientific realism debate are considered: the underdetermination of theory by data, the distinction between theoretical and observational terms, etc. In the new version of the argument the different approaches and perspectives offered on the issue by various philosophers of science - Laudan, Latour, Woolgard, Niiniluoto, Devitt, Leplin, van Fraassen, etc. - are discussed and analyzed. The arguments brought in favor or against scientific realism are to be analyzed taking into consideration the following aspects: the identification of some difficulties concerning the level of the language, and the necessity to clarify some of the terms involved, the types of arguments brought in the debate by each proponent. Then the arguments presented by both sides of the debate are to be evaluated. Finally, a short investigation concerning structural realism and its chance to be part of the solution in the debate will be offered.

Stanford's New Induction as an Evolutionary Debunking Argument

Sterpetti Fabio

Philosophy, Sapienza University of Rome, Rome, ITALY

The problem of the Unconceived Alternatives (UA) (Stanford 2006) has shifted the focus of the debate on theory change from the theories to the theorists (Saatsi et al. 2009). In fact, the New Induction (NI)

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proposed by Stanford (2006) is based on the historical analysis of the theorists' cognitive performances. Along this line the problem of the UA can be restated in evolutionary terms. Indeed, if knowledge is a human product, and humans are evolved biological organisms, then their ability in attaining true scientific theories must have evolutionary roots (Kornblith 2002). The problem is that "evolutionary approaches to the mind have given rise to two mutually incompatible positions" (De Cruz et al. 2011, p. 518): the first, supported by Evolutionary Arguments (EAs), contends that natural selection will lead to form beliefs that correspond with the state of the world; the second, supported by Evolutionary Debunking Arguments (EDAs) (Kahane 2011), denies such a claim. In this line of reasoning, it can be shown that the No Miracle Argument, normally used to support Scientific Realism (SR), is equivalent to an EA, while the NI can be described as an EDA. Recently Stanford's argument has been criticized by Lyons (2013). It will be assessed if formulating the NI as an EDA may help in defending it from such criticisms. Taking evolution into consideration is indeed deemed to be a challenge to some philosophical intuitions on knowledge (Nozick 2001). What is at stake here is trying to determine whether evolutionary considerations support the epistemological view which underlie SR or undermine it.

References: De Cruz, H., Boudry, M., De Smedt, J., Blancke, S. 2011, "Evolutionary Approaches to Epistemic Justification", Dialectica, 65, 517-535. Kahane, G. 2011, "Evolutionary Debunking Arguments", Noûs, 45, 103-125. Kornblith, H. 2002, Knowledge and Its Place in Nature, Oxford, Oxford University Press. Lyons, T.D. 2013, "A Historically Informed Modus Ponens Against Scientific Realism: Articulation, Critique, and Restoration", International Studies in the Philosophy of Science, 27, 369-392. Nozick, R. (2001): Invariances, Cambridge (MA), Harvard University Press. Saatsi, J., Psillos, S., Winther, R.G., Stanford, P.K. 2009, "Grasping At Realist Straws", Metascience, 18, 355- 390. Stanford, P.K. 2006, Exceeding Our Grasp, Oxford, Oxford University Press.

B3.10 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Thursday, August 6 • 11:00–13:00
Main Building, Room 13

Pan-Perspectival Realism

Teller Paul
Philosophy, UC Davis, Davis, USA

I work with 3 considerations. 1) Because the world is so complex, all human representation is to some extent imprecise and/or inaccurate. 2) Perception is or constitutively involves representation. Consequently 3) Not just scientific, but also perceptual knowledge is qualitatively affected with the limitations of 1).

What are those limitations? Standard Scientific realism fails for a simple semantic reason: Because of 1) we can't attach words to anything specific. (Whose atoms? Dalton's? Perrin's? Today's chemists? Many field theorists insist that there are no particles.) Standard Scientific antirealism assumed that when we let go of the theoretical, we could fall back on the things and properties we know by perception. Because of (3) that fails. (Consider the complexities of the still idealized current color science.) So the stakes are high: If we can't find some more nuanced way to be a realist, (3) will have to be interpreted as some kind of representational idealism.

For the same reasons that the sense data theory failed, a catalogue of representations, like a catalogue of pictures, can't get us even an "accurate enough" grip on the world. We have to understand the world as like one filled with our ordinary physical objects. Thinking in terms of ordinary physical objects, though still an idealization, tells us that our world is one very like one occupied by physical objects, despite the fact that if we examine too closely these turn out to involve idealization. This is as good as realism gets.

Finally, once we see how this works for the objects of perception, the same goes, for the same reasons, for the objects described by a successful science. This substantiates the long-standing conclusion that, because of the absence of any observational/theoretical distinction, objects of perception and of science have to be treated together.

Defining a Cumulative and Comprehensive Scientific Realism

Jetli Priyedarshi
Philosophy, University of Delhi, Delhi, INDIA

Defining a Cumulative and Comprehensive Scientific Realism By 'scientific realism' (ScR) I mean the cumulative history of philosophy of science from the mid-nineteenth to twenty-first century. My multi-faceted definition facilitates the understanding of the contemporary realism–anti- realism which is spurned on the fulcrum of the mind independent existence of unobservables. ScR is committed to ontological, semantic and epistemic realism of unobservables. Entity realists maintain a realism of unobservables while being neutral to or anti-realist towards scientific hypotheses. Constructive empiricists, social constructivists and relativists are anti-realists who deny one or more facets of the realism of unobservables. Semirealism and convergent realism as species of ScR broaden ScR so that it can convincingly meet the challenges of anti-realism.

I propose a definition of a comprehensive and cumulative ScR (CCScR) in which all tributaries of ScR, such as structural realism and entity realism stay under ScR without embracing anti-realism. The definition is purposefully vague to accommodate all the varieties of ScR. In constructing the definition I employ a four-fold distinction of observables, unobservables, relations and hypotheses, which further sub-divide to yield:

(I.1) observed observables, (I.2) unobserved (so far) observables, (II.1.1) detected detectable unobservables, (II.1.2) undetected (so far) detectable unobservables, (II.2) undetectable unobservables, (III) relations, (IV.1) empirical laws, (IV.2) physical laws, (IV.3) conventional laws, (IV.4) principles of nature, (IV.5) fundamental principles. These are considered in (A) ontological, (B) semantic and (C) epistemic tiers; hence making 33 conditions. Here are some examples: (1) CCScR-I.1A: Observed observables are mind independent existents.

(15) CCScR-II.2C: Knowledge of undetectable unobservables is through theoretical and experimental inference to the best explanation.

(32) CCScR-V.5B: Fundamental principles of nature are stated in differential equations that are multiply realizable.

A final minimalist physicalist condition is:

(34) CCScR-V: There is no emergent mental entity/process/event/world that is discontinuous with or supervenient over the physical world.

Reconstructed Empiricism

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According to Bas van Fraassen, scientific realism holds that accepting a theory involves believing that it is true. Van Fraassen's own constructive empiricism, by contrast, holds that accepting a theory involves only believing that the theory is empirically adequate, i.e. roughly correct in its claims about observable entities. Van Fraassen's empiricism is widely regarded as the most plausible anti-realist view available.

However, some philosophers – Simon Blackburn, Sam Mitchell, Paul Horwich and Paul Teller – have argued that acceptance and belief are conceptually identical. Thus, they argue, van Fraassen's realism debate is either confused or trivially settled in favor of the realist. Moreover, several philosophers – e.g. Grover Maxwell, Paul Churchland, Philip Kitcher and Marc Alspector-Kelly – have argued that constructive empiricism's reliance on the distinction between observable and unobservable objects is unmotivated. In support of this, realists often point out that it is hard to see what is in principle more problematic about beliefs concerning unobservable entities than beliefs about unobserved-but-observable entities.

This paper aims to reconstruct a van Fraassen-style empiricism about scientific acceptance. I start by clarifying what the issue of realism regarding acceptance could reasonably be in light of the Blackburn-Horwich-Mitchell- Teller objection. In short, I'll argue that realism ought to be conceived of as revolving around whether acceptance, like belief, "aims at" truth or merely empirical adequacy. Put differently, the realism debate about acceptance can be reconstructed around the normative question of whether a theory should be accepted only if it is true (or reasonably believed to be true). I then go on to argue that when the debate has been thus clarified, an empiricist position much like van Fraassen's constructive empiricism is quite plausible. In particular, I argue that the distinction between observable and unobservable entities is not unmotivated given this conception of the debate.

Abstraction, ideality and scientific representation

Dimitris Kilakos
Department of Philosophy and History of Science, University of Athens, Athens, GREECE

Process of abstraction (and/or idealization) is generally considered as constituent of scientific representation. This appeal to abstraction triggers serious issues, regarding their metaphysical and epistemological status. Indeed, on the ongoing discussion on scientific representations several approaches have been proposed, from those invoking fictionalism (i.e. Frigg 2010) to attempts to rescue realism (i.e. Psillos 2011).

I argue that we can account for neither their explanatory nor their predictive success if we do not indicate why and how the outcomes of abstraction which are included in scientific representations are real. This is a prerequisite to understand how scientific representations can be correlated and contrasted with things that are real and concrete.

I propose that E.V. Ilyenkov's elaboration of the concept of the 'ideal' can provide us an appropriate context for an account following these lines. Ilyenkov treats ideal phenomena as having a special kind of objectivity that fundamentally differs from the objectivity of things being empirically perceived by the individual: ideal is objective, part of objective reality, since it is something that is objectified in our various activities. Therefore, ideality is a feature of reified, objectified images of historically formed modes of human social life, which confront the conscious agent as special objects comparable with material reality.

I contend that in this context we can understand how aspects of the represented object or process, emerging via abstraction, are incorporated in its representation, enabling us to utilize it in our scientific inquiries. It is each specific scientific representation's function us such that determines the dynamics of the inquiry and not vice- versa. On these grounds, we can account for their function as tools for scientific cognition.

B3.11 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Friday, August 7 • 11:00 –13:00
Main Building, Room 13

Realism about quantities?

Wolff Johanna
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A realist about quantities holds that measurement procedures give us knowledge about quantities, where the latter are understood as entities that are in some relevant sense independent of the particular measurement procedures employed to determine them. An anti-realist about quantities holds that we can make sense of our measurement practices without introducing quantities as independent entities.

With the development of formal measurement theory, which captures a wide range of measurement scales, there seems to be less need for realism about quantities.

In this paper I argue in favor of a more realist approach to quantities, and lay out some conditions such a realism has to respect. A main consideration in favor of realism is the idea that in the establishment of a measurement scale, not just anything goes. A particular way of setting up such a scale is appropriate for a particular kind of quantity. I suggest that this appropriateness is best captured by assuming that the measurement aims to get right something about an independent entity. To avoid the restrictions of traditional realism about quantities, however, we must respect the idea that quantities can have different "structures", captured by scales at different levels of fine-grainedness.

I suggest that the best way to do so is structural realism about quantities. Structural realism about quantities is the idea that quantities are structures, characterized as relations among "positions", which may or may not be occupied. Understanding quantities as structures permits us to characterize a plurality of possible values for a quantity like mass, even in the absence of a large number of massive objects. This is an advantage both over nominalistically understood representationalism, and property based realism.

Robustness and Reality: How Science Justifies Ontological Commitments

Eronen Markus
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Robustness understood as multiple derivability, detectability or measurability has received increasing attention in recent years. A tendentious idea that is associated with robustness is that it may provide justification for the step from mere models to what is actually real. This idea comes up in different forms in the work of the proponents of robustness. Richard Levins famously asserted that the truth is at the intersection of independent lies. According to William Wimsatt, robustness is a criterion for the real. Michael Weisberg and Jaakko Kuorikoski and his co-authors argue that robust theorems give information about causal mechanisms. In this paper, I defend the idea that robustness should not be seen as a criterion for the real, but when properly understood and defined, it can provide justification for ontological commitments. What this means is that we are justified in holding something real if it is robust, that is, if it is detectable, producible, or derivable in a variety of independent ways. I elaborate and refine this view, and address several possible problems. I also illustrate the approach with an example from science (global warming), and finally consider the implications it has for the issue of scientific realism. As I will argue, robustness fulfills an important and neglected role in contemporary philosophy. Philosophers have traditionally focused on searching for a metaphysical criterion or definition for what is real, which results in claims such as "all real things are composed of fundamental physical particles". Such general principles are of little use if we are concerned with the (fallible) ontological commitments that current science justifies. In other words, traditional metaphysical approaches provide little help in answering the question: What are we justified in holding real now, as limited beings, based on the current state of science? Robustness provides one answer to this question.

Is there a third path: can a scientific realist be a mathematical antirealist?

Kocsis Laszlo
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According to the widespread (Quinean) scientific realism the indispensable truth-apt parts of our best theory about the natural world are true and the entities, over which we quantify in this theory, exist.

Some scientific realists – among others Hartry Field and most recently Mary Leng – want to be mathematical antirealists. They can be called nominalist scientific realists, since they do not believe in abstract entities, like mathematical ones, but they believe in concrete unobservable scientific entities, like electrons, i.e., they do not want to be scientific antirealists. However mathematical antirealism – the view that there are no mathematical entities referred by mathematical terms and mathematical statements are not (literally) true – seems to be the most well-known challenge to scientific realism. For we have good reasons to think that mathematics plays an indispensable role in our best scientific theories, for instance in physics, therefore scientific realism strongly implies realism about mathematics. Mathematics seems to be not just theoretically but metaphysically indispensable, at least if we accept the indispensability argument, presented first in the writings of Quine and Putnam, and developed recently by Alan Baker and Mark Colyvan.

Can a scientific realist be a mathematical antirealist? Nominalist scientific realists say: 'Yes!', but they must deny that mathematics has indispensable role in natural sciences. I want to show that they have not made a success of denying the indispensability of mathematics and so there are good reasons to think that nominalist scientific realism is not a tenable position. At the same time I want to present realism about mathematics as not a dreadful metaphysical conception: we can grant that mathematical statements are (literally) true and have indispensable role in scientific practices without accepting that mathematical entities have same ontological status as concrete physical (or other special scientific) entities have.

Towards a counterfactual account of extra-mathematical explanation

Heron John
Philosophy, King's College London, London, UNITED KINGDOM

According to the enhanced indispensability argument (EIA) for mathematical realism, we are justified in believing in mathematical objects because they play an 'indispensable explanatory role' in our best scientific theories. Cases of mathematical facts explaining non-mathematical facts are termed cases of 'extra- mathematical' explanation. Despite the central role that the notion of an 'indispensable explanatory role' plays in the EIA, there are remarkably few discussions that explicitly discuss this notion in light of contemporary accounts of scientific explanation. This paper has two aims. First, I suggest that James Woodward's counterfactual account of scientific explanation (Woodward 2003) can plausibly be extended to cases of extra- mathematical scientific explanation. This is despite extra-mathematical explanation being standardly understood as non-causal. I demonstrate the fruitfulness of this approach by showing that two of the most prominent cases of extra-mathematical explanation, (cicada with prime life-cycle lengths (Baker 2005) and the seven bridges of Königsberg (Pincock 2007)) can be helpfully made sense of by appealing to counterfactual notions. In the second half of the paper, I suggest that once extra-mathematical explanation is understood within the counterfactual framework, the mathematical realist loses her connection between an object playing an explanatory role and ontological commitment to that object. More broadly, I conclude that paying closer attention to what the realist means by 'explanatory role' can have serious ramifications for the success of the enhanced indispensability argument.

Baker, A. (2005), 'Are There Genuine Mathematical Explanations of Physical Phenomena?', Mind, Vol. 114 pp. 223 - 38. Pincock, C. (2007), 'A Role for Mathematics in the Physical Sciences', Nous, Vol. 42. pp. 253 - 275 Woodward, J. (2003), Making Things Happen, New York: Oxford University Press

B3.12 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 14:30–16:30
Main Building, Room 17

Robert Boyle's chemistry and the ontological status of dispositional properties

Fraguito Hugo
Philosophy, New University of Lisbon, Lisbon, PORTUGAL

Robert Boyle is famous for his defence of the mechanical philosophy and his experimental works on chemistry. And, of all the British natural philosophers of the mid-seventeenth century, it is he who carried out the most detailed experimental work on the qualities of bodies and produced the most sustained theoretical expositions of the corporeal qualities. His impact on Newton and Locke's understanding of the qualities of bodies is widely known. In Boyle's most important theoretical work on qualities – The Origin of Forms and Qualities –, he presents arguments against the Peripatetic doctrine of sensible qualities, according to which all qualities attributed corporeal objects are intrinsic properties. For Boyle, sounds and colours are not intrinsic properties of the bodies, but relational properties that depend on the primary mechanical structural qualities of the body and on the existence of a percipient. About other qualities he doesn't say much, and he expresses his views on the dispositional properties of bodies with the celebrated "lock and key" analogy. This analogy suggests that Boyle considers powers and capacities to be relative properties that depend on the primary mechanical qualities of the bodies. But it is not clear what their ontological status is. There were authors who tried to determine this status, but their answers are not conclusive. One of the main reasons is that their analyses are limited to the content of Forms and Qualities and to some other more theoretical texts like Cosmicall Qualities. Given the nature of Boyle's works, to understand what dispositional properties are it is necessary to take into account his works on chemistry, where powers and capacities play an important role. In the presentation I consider some of these works in order to determine the ontological status of dispositional properties.

The 'one-world' interpretation of kantian transcendentalism view of quantum non-separability

Hadzidaki Pandora
Philosophy and History of Science, University of Athens, Athens, GREECE

This paper attempts to detect possible substantial links between Kant's philosophy of science and modern physics within a realistic framework. For this reason, it reads the Kantian distinction between 'things in themselves' and 'phenomena' in the light of its 'one world' interpretations claiming that Kant is committed to a certain form of realism. On this view, there is one metaphysical realm of entities in Kant's ontology, the realm of physical reality: Kant's 'phenomena' represent, not mental states or activities, but actually existing physical entities, as these entities are inter-subjectively schematized by the knowing subjects. This claim obliges the 'one world' interpretations: first, to give a sense in which 'phenomena' are minddependent that does not involve existence in the mind, second, to explicate Kant's doctrine that we cannot know things as they are in themselves, and, third, to elucidate Kant's view that 'phenomena' and 'things in themselves' have a genuinely different status. On these issues, the opinions diverge. In the present work, I critically consider the relevant opinions of Langton (1998), Allais (2004) and Mueller (2010) from the viewpoint of a realistic interpretation of quantum theory, which sets as key-stone of its constitution the assumption that quantum non-separability encodes an essential feature of physical reality, i.e., it refers to an ontologically non-separable world, a world populated by objectively indefinite natural entities, by entities subject to entanglement. The development of this view requires the introduction of two crucial conceptual distinctions: a) the distinction between 'subatomic entity' and 'quantum object', and b) the distinction between 'physical reality', as domain of reference of quantum theory, and 'empirical reality', as domain of reference of 'quantum objects'. The thorough analysis of the concepts involved in these distinctions faces the issues dividing the 'one world' interpretations, and examines, in parallel, the compatibility of the latter with modern physics. I think that this dialogue opens new perspectives in both Kant's philosophy and the philosophy of science.

The logical form of laws of nature

Friend Toby
Science and Technology Studies, UCL, London, UNITED KINGDOM

Within philosophy, the logical structure of scientific laws is often expressed in the form $\forall x(Fx \supset Gx)$. Needless to say, recent literature in philosophy of science is overflowing with criticism of this caricature. Tim Maudlin has complained, with regard to Newton's law of gravity and Schrödinger's time-dependent wave-equation, that "[n]o doubt these can be tortured into a form similar to $\forall x(Fx \supset Gx)$, but it is hard to see what the purpose of the exercise would be" (2007:11). More generally, we must concede that equations do not clearly have the form $\forall x(Fx \supset Gx)$. But if many of the so-called `laws' in science are represented as equations, how can this schema capture their logical form?

I will offer an argument which concludes not only that we can render many of our laws commonly expressed as equations in the form $\forall x(Fx \supset Gx)$, but that doing so is conceptually necessary and so, pace Maudlin, both useful and untorturous.

Focusing on the gas law as a case-study, I argue that any plausible interpretation of the equation "PV=nRT" either renders it a denoting expression for a set of functions, and therefore non-propositional, or else a trivial falsity about second-order relations over properties or a trivial truth of mathematics. For the equation to be informative and general I argue that we must understand its property-terms as predications of a variable bound by the universal quantifier. I then show that the resulting statement is still trivially false unless we qualify it with the antecedent clause that any value taken be an instance of a particular system-type: an ideal gas. Hence the ideal gas law is shown to be an instance of the schema $\forall x(Fx \supset Gx)$.

This argument generalises to all equations commonly used to represent laws as well as those, such as the Lotka-Volterra and Schrödinger equations, not directly associated with any 'law'. I end by drawing some conclusions for the debate on ceteris paribus laws, ideal-system laws and the nature of 'governance'.

Natural vs. Artificial Distinction

Havlik Vladimir
Department of Analytical Philosophy, Institute of Philosophy, Prague 1, CZECH REPUBLIC

From the philosophical point of view the distinction between natural and artificial is the basic question that fundamentally affects other considerations and conclusions in many fields of philosophy of science (e.g. experimental and theoretical practice of science; biological sciences; natural and cultural dimension of science; artificial intelligence; etc.). The intuitive and traditional position of this distinction can be connected with the strict separation of these opposites. In this case, the separation alone is dependent on whether something is man-made or not. On the other hand there are many instructive examples (e.g. artificial and natural selection; Hacking's conception of natural and artificial in the experimental practice of science; distinction between natural things and artefacts), which show that the distinction is not so sharp. From this perspective, we cannot claim that anything is purely natural or unnatural. We must accept that "instead of opting for an absolute distinction of quality between the artificial and natural, one should accept only a gradual distinction of degree" (Bensaude-Vincent and Newman 2007). I want to show that not only this distinction can have a range of graduality, but it can disappear in an appropriately chosen perspective. This philosophical perspective finds some support in Daniel Dennett's conception of intentionality (Dennett 1996). What is attractive in Dennett's conception is the insight into the genesis of intentionality and understanding that the prime apparent distinction between intrinsic and derived forms could disappear. Based on Dennett's conception of intentionality I try to show that besides the traditional conception there is another perspective in which the natural-artificial distinction disappears. Some conclusions will be considered in the various fields of philosophy of science.

B3.13 METAPHYSICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 17:00–18:30
Main Building, Room 14

Hooking On and Biting Back: A Defense of Longino's Account of Objectivity

Fellows Jennifer
Philosophy, Douglas College, New Westminster, B.C., CANADA

In her recent paper Karyn L. Freedman has argued that Longino's account of objectivity cannot claim to be epistemically valuable because it fails to defeat the relativist. She argues that for an account to defeat the relativist it must be able to do three things: guarantee epistemic accuracy of our theories, ensure that reality bites back when our theories are wrong-headed, and guarantee that we will never ratify two contradictory hypotheses as knowledge simultaneously. In the following paper I offer a defense of Longino's account of objectivity as epistemically valuable by illustrating that Longino's account can defeat one particular type of relativisim. However, I claim that the root of Freedman's objections to Longino's account is a disagreement over what is metaphysically possible. Freedman sees two possibilities: monism and relativism. Longino suggests a third possibility: pluralist realism. In order to find Longino's account to be an intelligible overcoming of one type of relativism, one must also find pluralist realism to be a metaphysical possibility.

Extended Agents and Development of Science and Technology

Nakayama Yasuo
Graduate School of Human Sciences, Osaka University, Suita, Osaka, JAPAN

Until the first half of the 20th century, epistemologists used to take individualistic positions. For example, some logical positivists took methodological solipsism. In 1960s, Thomas Kuhn succeeded in introducing some components of collective epistemology into philosophy of science. However, Kuhn paid little attention to technological devices for experiments and observations.

In this presentation, to connect collective elements of epistemic agents with technological devices, we use a notion of extended agent that is proposed in [The Extended Mind and the Extended Agent, Procedia Social and Behavioral Sciences, 2013, vol. 97: 503-510]. Then, we describe developments of science and technology in terms of extended agents. This definition of extended agent presupposes a position of four-dimensionalism that allows us an extensive use of the notion of temporal part. (a) An atomic agent is an agent. It is four-dimensionally extended and any spatial part of it is no agent. (b) Let temporal-part(x,t) denote the temporal part of object x in time t. Let A be an agent that uses (tool) B in time t in order to perform an action. Then, the mereological sum of temporal-part(A,t) and temporal-part(B,t) is an agent.

(c) If agents A1, … , An perform a joint action, then A1 + … + An is an agent. Here, we use + as an operator that builds a mereological sum of given objects.

(d) If an object satisfies neither (a) nor (b) nor (c), then it is no agent.

(e) An agent that is not atomic is called an extended agent.

According to this definition, multiple researchers and multiple technological devices can be components of a single extended agent. Then, we can assign epistemological states to these extended agents. An aim of this presentation is to describe interactions between science and technology based on a position in analytic metaphysics.

B4

B4.1 ETHICAL AND POLITICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Saturday, August 8 • 10:00–12:00
Main Building, Room 3

Life for science in another world

Mehdi Damaliamiri
Science, Farhangian University, Hamedan, IRAN
Firouzeh Akbari, Civilization, Hamedan, IRAN

The presence of red lines in religious impositions, especially in Islam, on scientific issues in some scholarly circles has limited the ever-expanding nature of science especially in humanities. While these limitations come from ethics and tradition, profound changes in politics, the structure of internal affairs and culture during recent decades have led inside Islam to the problem of the ”Aggiornamento” ; the adjustment to a knowledge of the demands of the times and the adaptation and practice of religion in a new industrial milieu ; in a way similar to what happened within the Catholic Church. The old mysticism and asceticism still survive alongside this rationalism, together with the forms of their degeneration. A particular tendency is the close connection between Sufism and Pantheism observable today in Islamic countries, especially in Iran. The dichotomy of religious science and non-religious science has brought about two trends of search for knowledge and even two different procedures in practice of science. The application of Islamic psychology and western psychology, based on Islamic ethics, has proposed two different treatments for patients. These prescriptions of ethics have been affected by socialism and globalization. This paper discusses the problem of introducing ethics in science.

Peirce on belief and explanatory hypotheses

Gaultier Benoit
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

In this presentation, I argue that Peirce’s claim that “belief has no place in science” is intimately connected to his view of the purpose and nature of explanatory hypotheses. For Peirce, when a scientist tries to find an explanatory hypothesis H capable of accounting for certain surprising facts F, the question that is occupying her mind is: “Could the explanatory hypothesis H be the right one?”. The crucial point is that for Peirce endeavouring to answer this question is to be clearly distinguished from wondering whether the explanans indicated by H is (probably) the case. Correlatively, when one believes H to be such that it could be the right explanation of F, one does not believes that H is (probably) the right explanation of F. It’s not even supposing or guessing that H is the right explanation.

After having exposed the rationale and exact significance of Peirce’s view, I indicate the role he attributes to the experimental testing of H. More specifically, since Peirce rejects (rather counterintuitively) the idea that its role is to determine how probable it is that H is the right explanation of F, the question that deserves to be asked is: “What could be learned from an experimental trial, and from an experimental trial only, about the question whether the hypothesis tested is a good one, but not about its being (probably) true or not?”.

I indicate what I take to be Peirce’s answer to this question, and reject one important objection that could be made against it: belief clearly has a place in science if the attitude one should have towards H does not consist in having another kind of doxastic attitude than belief vis-à-vis the question whether H is (probably) true, but rather consists in wondering whether H is such that it could be true, and then in believing that H could be so, or could not be so. However, I argue that this is not really a problem for the coherence of Peirce’s view: since believing that H is such that it could be the right explanation of F does not exclude in any way—contrary to believing that H is the right explanation of F—believing that there may be other possible explanations of F, such a belief does not block the road of inquiry in the way believing that H is the right explanation of F blocks it according to Peirce. It might then be objected that believing that H is such that it could be the right explanation of F excludes, in reality, the possibility of H being false, and so well and truly implies a form of dogmatism that blocks the road of inquiry: if H is false, then (trivially) H cannot be the right explanation of F. Therefore, so the objection goes, believing that H is such that it could be the right explanation of F implies believing that if the results of the experimental testing of H were contrary to H, this would not amount to a reason to reject H. Worse still, having the belief in question implies believing that there is no point in putting H to the test—which is patently absurd. I refute this objection and indicate some interesting consequences of Peirce’s view about the relation between scientific inquiry and practical matters.

Science and Wishful thinking

Tomáš Ondrácek
Philosophy, Masaryk University, Brno, CZECH REPUBLIC

People should be equal but sadly they are not. Despite of our wishes, our ambitions, people differ in many ways. Some are stronger, some are smarter, some are prettier and some are richer and so on. Though we know this sometimes we pretend that this is not the case.

Wishful thinking is common in many areas of our ordinary life and science is not an exemption. Even there people make decisions, research plans, applications according to their wishes and ambitions and sometimes further more against evidence. But science based on wishes rather than on evidence is not a good science and such science could be even harmful.

In 1978 Bernard David Davis (1978) presented problem of wishful thinking in science as the moralistic fallacy, a problem of derivation “is” from “ought to” (Matt Ridley (1998) called this problem a reverse naturalistic fallacy). Davis and others (Pinker, 2003) showed some examples of this problem and they pointed out the harm which can be done if this occur. But while the naturalistic fallacy, the switch from descriptions of how things are to statements of how things ought to be, has been widely discussed, moralistic fallacy was left behind. But this fallacy is still present in contemporary science and some of the examples can be found in very problematic fields like testing of intelligence, race and culture differences.

In my lecture I will deal with the problem of harmful wishful thinking, moralistic fallacy, in science. To put it more exact, I will discuss the examples of harmful restriction of scientific research by ethics, in a broad sense (not only research ethics). The necessity of the difference between intentions or wishes and facts, the necessity to take care of the results of examinations regardless of our fears or convictions will be shown and defended.

B4.2 ETHICAL AND POLITICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Tuesday, August 4 • 17:00–19:00
Main Building, Room 4

Characteristics of TA institutions by the Difference of Governance

Lee Seung Ryong
Office of Strategic Foresight, Korea Institute of S&T Evaluation and Planning, Seoul, SOUTH KOREA

The development of science and technology produces economic added values as we have expected from the beginning, but somehow it also causes unexpected effects such as environmental or ethical problems. As a society has mingled with S&T, an impact that S&T influences to the society has become more complex and huge, which makes concerns of the public about S&T bigger, and increases the importance of participation of civilians.

Technology Assessment(TA) was introduced in 1970 and has been institutionalized in various countries to carry out socio-economic responsibilities of S&T. But the methodologies and institutions vary depending on the purpose of TA and the culture of a society. USA has institutionalized TA at the assembly-affiliated organization and conducted with an expert orientation for offering S&T agenda to assembly man. Europe also has started TA closely related with parliament, but differences exist. While parliament governs TA directly in France and assembly-affiliated organization performs TA in UK, Northern European countries such as Denmark and Netherlands organize independent organizations for TA and put high priority to public participation. In Korea and Austria, TA has been institutionalized and performed by the administration. In the case of Korea, on the basis of "Framework Act on Science and Technology," the Government shall assess the effects of new S&T to the economy, society, culture, ethics, environment, etc., and reflect results of TA in formulating policies. And the Act recommends participation of civilian experts and civic organizations for TA. The purpose of this study is to compare the characteristics of TA by differences of governance. We categorize TA governance into four groups: US OTA, assembly-affiliated, independence organizations and the government. Then we examine the relationship with stakeholders (parliament-government-society-science researcher) and the role of participants. Also the aims, methodology, emphasis in assessment and pros and cons of each TA governance will be analyzed.

How can Bayesians help communications on climate change?

Iseda Tetsuji
Philosophy and History of Science, Kyoto University, Kyoto, JAPAN

One of the standard criticisms of Bayesian epistemology is that actual scientists never talk about degrees of beliefs and never update their beliefs probabilistically. Even if the criticism is true, Bayesians can reply to it with adopting a two level model of scientific methodology. However, here is a striking example of scientists who explicitly use degree of belief talk: the IPCC (Intergovernmental Panel on Climate Change) assessment reports on climate change. Those reports (especially the latest ones) utilize expressions like "very likely," "very high confidence" in a systematic manner, with corresponding numerical values (such as "very likely" means "90-100

percent probability"). We can also see that IPCC is updating its level of confidence if we compare changing expressions throughout successive reports. The editors of the reports even issue guidance for authors as to how they should use such probabilistic expressions. This case offers Bayesian philosophers a chance to reflect on the practical implication of their philosophy. There are several points to think about. First of all, IPCC assessment reports are not collections of scientific papers or survey articles; they are primarily tools for communication between climate scientists and concerned laypeople and policy makers. The very fact that one of rare cases in which scientists explicitly use 'confidence' talks is such a communication situation gives a suggestion for the appropriate role of Bayesianism in actual science.

Second, even though the IPCC reports utilize 'confidence' talk, the details do not seem to fit exactly with mainstream Bayesian philosophy. For example, the latest report adopts a two-dimensional model of confidence, rather than an ordinary one-dimensional probability scale. How should philosophers react to such features? Is this a chance for philosophers to offer practical advice to scientists, or is this rather a chance to reconsider the mainstream Bayesian philosophy itself?

Think Tank Research as Scientific Expertise

Välikangas Anita
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In the last few decades, the amount of scientific research that has been produced by research institutions with a think tank orientation has increased significantly. Usually, think tank research is generated especially in order to influence policy making. This increase in the volume of think tank research has had an effect especially to the traditional domain of social sciences, as it has been traditionally been quite closely connected to that kind of topics that have relevance from the viewpoint of politics and policy-making. Despite the large social and political impact of think tank knowledge, the question of how to understand scientific credentials of think tank research has not received much examination in philosophy of science. This paper suggests that the ideas developed under the discussion on scientific expertise might help us to understand better the scientific credentials of think tank research. Research produced within think tanks is very different from the traditional conception of good scientific knowledge. It does not, for instance, follow the classical Mertonian norms for ideal scientific research. Yet at the same time, think tank research has many similarities with those criteria that are traditionally given to good academic science. Think tank organisations may contain peer-review mechanisms, they may do systematic data collection or use official data, and they may have a strong pursuit of producing valid, neutral and policy- relevant information. In many cases, people employed by think tanks attempt to conduct their research in such a manner that it would produce good and neutral information on a certain policy issue. To label all think tank knowledge as an ideological tool used in order to legitimize certain political course of actions – as has been sometimes done in the critique on think tanks – seems quite harsh. What we need, at least, is to have a more nuanced view on how think thank research is situated in the expanding field of scientific research. The paper suggests that by understanding the claims for scientific backing in the context of think tanks, the better we are to make comparisons between different forms and qualities of think tank research.

B4.3 ETHICAL AND POLITICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 14:30–16:30
Main Building, Room 16

Inductive Risk, Epistemic Risk, and Overdiagnosis of Disease

Biddle Justin
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Philosophers interested in the role of values in science have focused much attention on the argument from inductive risk. In the 1950s and 1960s, Richard Rudner and Carl Hempel argued that value judgments play an ineliminable role in the acceptance or rejection of hypotheses. Recent philosophers of science have not only revived this argument; they have extended it. While Rudner and Hempel focused on one point in the appraisal process where there is inductive risk – namely, the decision of how much evidence is enough to accept or reject a hypothesis – more recent philosophers of science have argued that there is inductive risk at multiple points in the research process. The upshot of these and other extensions of the Hempelian/Rudnerian argument – which I will call the classical argument from inductive risk – is that the research process is shot through with inductive risk. While I applaud the revival of the classical argument from inductive risk, I will argue that some of the purported extensions of the classical argument do not fit cleanly within the schema of the original argument and that, for the sake of conceptual clarity, they should simply be treated as different arguments. I will discuss the growing problem of overdiagnosis of disease due to expanded disease definitions in order to show that there are some risks in the research process that are important – and that should be taken seriously by philosophers of science – that very clearly fall outside of the domain of inductive risk. Finally, I will introduce the notion of epistemic risk as a means of characterizing such risks. This more fine-grained taxonomy of risks in the research process will help to clarify the different roles that values can play in science.

Value free or not, in terms of whether qua science or qua scientists

Matsuo Masahiro
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Since the distinction between epistemic and non-epistemic values was introduced in 'value free science' disputes in philosophy of science, what has mainly been discussed seems to be whether the latter values have a proper place in science qua science. That is, apparently the focus of interest has been to search for or select values that could be seen involved in science as its indispensable components, whether the aim of science is taken realistically or non-realistically. Indeed, this line of arguments is fruitful, in so far as we could make clear and evaluate roles of values in science usually unnoticed even by scientists themselves. But we should notice here that this kind of argument is apparently based on some assumption about 'what is a sound science'. It usually starts (particularly in defending social value roles) with taking some scientific practices as 'good' examples in order to vindicate the point they make, but at the same time, it rests on some soundness of scientific practice presupposed in them. I think by this assumption, philosophers are now making their arguments risky. One of the important origins of present disputes can be traced back to Rudner's argument. As his paper's title indicates, his interest was in the value judgment by scientists qua scientists. Though the present arguments assume that the validity of value use required for science and that for scientists are the same, I think we should rather make some distinction between the two in order to make the whole argument meaningful (also for the society) and to avoid unnecessary confusion, which we see in the actual arguments. This point seems particularly important when we think of moral responsibility of scientists. I'll talk about this mainly by distinguishing two kinds of uncertainty along the case of the difficulty Japanese seismologists confront after 3.11.

B4.4 ETHICAL AND POLITICAL ISSUES IN THE PHILOSOPHY OF SCIENCE

Friday, August 7 • 17:00–19:00
Main Building, Room 3

Can Dissent in Science be Epistemically Detrimental? Notes on a Recent Debate

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While dissent in science is normally epistemically fruitful, there are recent debates whether particular sorts of dissent in science can be epistemically detrimental. E.g., contrarian studies in climate science are used by industrial and political stakeholders as a basis for personal and professional attacks on climate scientists in order to undermine the authority of science to postpone inconvenient political action (Oreskes & Conway 2010).

As Biddle and Leuschner (forthcoming) argue such dissent has an influence on the findings of climate science: the attacks cause a systematic underestimation of climate change and its impacts because scientists are intimidated. In fact, empirical sources indicate that there is such lopsided distribution of inductive risks in climate science, and anecdotal evidence indicates that this is due to the attacks on climate scientists. Others argue, in contrast, that there is an overestimation of these issues because scientists seek to distance themselves from the skeptical camp (DeMelo-Martin & Intemann 2013). Still, in both cases the skeptical dissent is epistemically detrimental. I want to defend this thesis against two objections.

(1) Even the dissent from climate skeptics might have positive side effects on the advancement of climate science. E.g., the "warming hiatus" would be largely a scientific non-issue if it had not become a prominent sceptical theme. I'll answer that the dissent is still epistemically detrimental. It is the side effect which is epistemically fruitful; it could be achieved without that dissent.

(2) The dissent from sceptics is not scientific. Hence, there might be epistemically detrimental dissent, but not in science. Real scientific dissent is always epistemically fruitful. I'll answer that there are sceptical scientists being really concerned about the credibility of mainstream climate science. Their dissent can still be epistemically detrimental.

References: Biddle, Justin & Anna Leuschner (forthcoming). Climate Skepticism and the Manufacture of Doubt: Can Dissent in Science be Epistemically Detrimental? European Journal in Philosophy of Science. De Melo-Martin, Inmaculada & Kristen Intemann (2013). Scientific Dissent and Public Policy. EMBO reports, 14 (3), 231–235. Oreskes, Naomi & Eric Conway (2010). Merchants of Doubt. New York: Bloomsbury Press.

How (not) to make philosophical proposals about social organisation of science

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What considerations should a philosophical proposal about the social organisation of science take into account? James Robert Brown (2008) proposes "socialising" science to overcome epistemic problems caused by its commercialisation. Brown argues that, given the epistemic justification of the proposal, it should not be criticised in terms of social values it may help to advance. I argue that possible strategies for justifying this immunity are problematic and that discussing the acceptability of likely social consequences of a proposal cannot be justifiably avoided. At the opposite end of the spectrum, Janet Kourany argues for "socially responsible science" that adopts the advancement of the "egalitarian ideal of human flourishing" (Kourany 2003 , 6) as its aim. Kourany uses the underdetermination thesis (the possibility of alternative empirically adequate theories on the basis of the same evidence) in order to defend her proposal from epistemic criticism: theories developed on the basis of egalitarian ideal may be different but still can, and are required to, be empirically adequate. I argue that Kourany makes a mistake that mirrors Brown's when she excludes as unnecessary discussion of particular epistemic consequences of her proposal on the basis of a problematic general assumption. I conclude that regardless of the primary aim—improving science epistemically or making it more socially relevant—one has to defend the acceptability of one's proposal in light of both social and epistemic consequences.

References Brown, James R. (2008). "The Community of Science®". In: Carrier, Martin, Don Howard and Janet A. Kourany (eds.) The Challenge of the Social and the Pressure of Practice: Science and Values Revisited. Pittsburgh: University of Pittsburgh Press, 189–216. Kourany, Janet A. (2003). "A Philosophy of Science for the Twenty-First Century". Philosophy of Science 70(1): 1–14.

Defining, quantifying, and assessing diversity in science

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Diversity is among the central issues in today's philosophy of science; it is at the core of debates about pluralism, dissent, justice, or the division of cognitive labor in science. However, illustrious as it may be, the concept is not yet well understood and remains fairly unclear. This paper aims to remedy this shortcoming by addressing conceptual questions like: "How can diversity be defined precisely?", "Which relations hold between its several scientifically relevant SUBTYPES (social, axiological, methodological, theoretical, subject matter diversity, etc.)?", "(How) is it possible to quantify these subtypes?" Using the ecological notion of biodiversity as a starting point, in the first part I develop a model of diversity in general. Here is the outline of this model (cf. the attached figure). There is some field F which contains a number of typical elements A1...An. Every A-element stands in some characteristic relation R to elements B1...Bn. One can now define a couple of DIMENSIONS of diversity, the most important of which are Richness (i.e., the number of As in F), Evenness (i.e., the degree to which the Bs are equally distributed among the As), and Dissimilarity (i.e., the average disparity between any two As in F). In the second part, I apply these dimensions to the various subtypes of scientific diversity and, in doing so, explore how these types can be defined and quantified. In particular, I correlate each type with each dimension and discuss what it would mean to maximize diversity on this dimension. Finally, I discuss interconnections between the subtypes and draw some conclusions for the debates about dissent, pluralism, and objectivity in science. I conclude that many, but not all, types of diversity are to some extent epistemically valuable, and that in most cases achieving an optimal level of diversity is not tantamount to maximizing diversity.

The epistemology-metaphysics relationship in Helen Longino's philosophy of science and its consequences for social criticism

Kovács Ágnes
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The paper analyzes Helen Longino's theory of science and social epistemology of science, together known as critical contextual empiricism, as laid out in her 1990, 2002 and 2013 books and in-between publications on local epistemologies and on scientific pluralism. I will argue that certain meta-philosophical commitments, i.e. the conception of the epistemology-metaphysics and the science-philosophy relationships limit contextual empiricism's capacity to promote a socially responsible science and philosophy of science.

Critical contextual empiricism is both a descriptive and a normative account of the role of values in science. It distinguishes three levels of analysis: (1) scientific theories (2) research programmes/paradigms based on standards of evaluation and argumentation which Longino calls "local epistemologies", and (3) universal epistemology, which articulates norms for transformative critical interaction within and between knowledge- producing communities that endorse different sets of standards. Local epistemologies consist of metaphysical assumptions, contextual (social, political, and cultural) values, and epistemic or cognitive values, which too are ultimately socio-political. The first two levels are possibly value-laden and plural, whereas the third is meant to be value-neutral and singular.

Because of Longino's (empiricist) commitment to the separation of epistemology and metaphysics, the metaphysical components of the first and second levels remain philosophically unjustified. Similarly, due to the separation of (social) science and philosophy, the socio-political values operating on these levels are too philosophically unjustifiable. In consequence, theories and paradigms predicated on different and even conflicting values and metaphysical assumptions appear to be equally rational, due to the imperviousness of their ideological and metaphysical contents to both scientific and philosophical justification. This leads Longino to advocate the permanent coexistence of competing research programmes and to call into doubt the ability of the sciences to jointly provide a comprehensive and metaphysically correct representation of the world, the very feature that would enable them to aid progressive social change.

B5

B5.1 HISTORICAL ASPECTS IN THE PHILOSOPHY OF SCIENCE

Saturday, August 8 • 13:30–15:30
Main Building, Room 3

Poincaré on Beauty in Science

Ivanova Milena
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Poincaré's philosophy of science has caused significant debates in the contemporary literature. However, his views on the aesthetics of science have received little attention. This paper offers a systematic analysis of Poincaré's understanding of beauty in science. I argue that for Poincaré beauty plays a motivational role in our exploration of nature and that beauty reduces to the elegance and unity of our scientific theories. According to Poincaré the aim of science is to offer us understanding of the underlying relations between phenomena, of the harmony in nature. It is in this underlying harmony or unity that our theories uncover that we find beauty. Beauty is an aesthetic property that reduces to the elegance and unity of our theories.

I examine the epistemic significance Poincaré attributes to aesthetic judgement by reconstructing and analysing his arguments on the roles simplicity and unity play in science. I show that while Poincaré believes simplicity, as an aesthetic property of theories, plays a heuristic role in scientific theorising, unity has a different status. Unity – which

Poincaré identifies with the aesthetic emotion felt when one comprehends the hidden kindship in nature revealed by our theories – is the ultimate goal of science and a regulative ideal in scientific practice. This account, I argue, shares elements with Kant's theory of aesthetic judgement because it offers a middle way between an objectivist and a projectivist account.

Finally, I explore how this theory of beauty in science fits with Poincaré's overall philosophy of science. I argue that Poincaré's stance towards aesthetic considerations in science offers new insights for his position in the scientific realism debate. I argue that his account of aesthetic considerations in science depart him from the traditional scientific and selective realists, contrary to a consensus in the recent literature.

The winding road between true knowledge and moral certainty in Descartes' philosophy of nature

Monroy-Nasr Zuraya
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Descartes' definition of "scientific knowledge" is strict. It only admits what is certain and evident, in the sense of indubitable. True knowledge is characterized in this manner. Cartesian philosophy has been predominantly understood as radical rationalism. Nevertheless, in the last decades of the 20th century interpretations emerged recognizing the fundamental role of experience (and experiment) in Descartes' philosophy of nature and in his epistemology of science. Then, the pressing question becomes whether Descartes can maintain and justify true knowledge of the physical world or if he has to recognize that his physical science merely achieves practical certainty.

First, I intend to show that from its origins Descartes' natural philosophy stands apart from pure speculation and instead demands that scientific principles be tested. Even more, Descartes affirms that the more the knowledge advances, the larger the need for experiences that test its validity. Second, I will argue against interpretations on the gradual certainty in Descartes' philosophy of nature. D. Clarke has defended theses that try to support the idea that Descartes admits moral or practical certainty in his natural philosophy. Therefore, he would accept doubt and probable knowledge in this domain. I fully recognize we owe to Clarke the recognition of the role of experience in Descartes' philosophy of science. Nonetheless, I disagree with his vision of Cartesian certainty in science. Consequently, I argue that Descartes claims metaphysical certainty for knowledge of the natural world, and rejects probable knowledge in the domain of physical science.

Leibniz's Theory of Time

Uchii Soshichi
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I have developed an informational interpretation of Leibniz's metaphysics and dynamics, but in this paper I will concentrate on his theory of time. According to my interpretation, each monad is an incorporeal automaton programed by God, and likewise each organized group of monads is a cellular automaton (in von Neumann's sense) governed by a single dominant monad (entelechy). The activities of these produce phenomena, which must be "coded appearances" of these activities; God determines this coding. A crucially important point here is that we have to distinguish the phenomena for a monad from its states (perceptions). Both are a kind of representation: a state represents the whole world of monads, and phenomena for a monad "result" from the activities of monads. But the coding for each must be different; R(W) for the first, Ph(W) for the second, where W is a state of the monadic world. The reason for this is that no monadic state is in space and time, but phenomena occur in space and time. Now, the basis of the phenomenal time must be in the timeless realm of monads. This basis is the order of state-transition of each monads. All the changes of these states are given at once by God, and these do not presuppose time. The coded appearances (which may well be different for different creatures) of this order occur in time (for any finite creatures), and its metric must depend on God's coding for phenomena. For humans, in particular, this metric time is derived from spatial distance (metric space) via the laws of dynamics. Thus there may well be an interrelation between spatial and temporal metric. This means that the Leibnizian frame allows relativistic metric of space-time. I will show this after outlining Leibniz' scenario.

Tacit Knowledge and Logical Positivism

Koterski Artur
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One of the key arguments in the so-called anti-positivist turn was based on the idea of tacit knowledge, as given by Michael Polanyi and Thomas Kuhn. In the late 50s and 60s they independently formulate and support the claim that the tacit knowledge plays a most important role in science: This means that the identification of scientific knowledge with verbalized knowledge is wrong—as is the sentential conception of science that lied at the bottom of logical positivism.

The task of this paper is to examine whether the tacit knowledge argument is indeed detrimental to logical positivism, understood, however, not as the received view but more broadly, as 'scientific conception of the world.' There is no single and generally accepted characterization of tacit knowledge and, understandably, some of its versions may be principally incompatible with neo-positivism. This, however, by no means implies that no concept of tacit knowledge fits 'scientific conception of the world' and to illustrate it Ludwik Fleck's conception of tacit knowledge will be indicated. This is obviously not to say either that the idea of tacit knowledge never entered any doctrine advocated by neo-positivists. To show that it actually appeared in their teaching—even if only implicitly—Otto Neurath's theory of pictorial language will be invoked.

I take the result obtained here, on the one hand, to be one more argument that the 'anti-positivist turn' noticeably mishit its target; on the other one, it should support the claim about evolving character of logical positivism.

B5.2 HISTORICAL ASPECTS IN THE PHILOSOPHY OF SCIENCE

Friday, August 7 • 17:00–19:00
Main Building, Auditorium II

Franz Roh as the missing link between Rudolf Carnap and Otto Neurath

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Franz Roh (1890-1965) was one of the most important German art historians of the last century. Beside of that, Roh has been a close (and lifelong) friend of both Rudolf Carnap and Otto Neurath, and, actually, he also established the connection between Carnap and Neurath. Against the background of recent studies on that topic by Hans-Joachim Dahms, Günther Sandner, and Christian Damböck, this paper evaluates the role that Roh played for the friendship of Carnap and Neurath, and the way how Roh – a student of Herman Nohl and therefore a member of the Dilthey-school – has influenced both Carnap and Neurath. The sources that will be used for that purpose are (1) the correspondence between Roh, Neurath, and Carnap as available at the Roh Nachlass Getty Center for the History of Art and the Humanities Santa Monica, at the Carnap Nachlass Archives for Scientific Philosophy, Pittsburgh, and at the Neurath Nachlass Wiener Kreis Archief, Noord- Hollands Archief, Haarlem, (2) Roh's unpublished (and by now completely neglected) philosophical writings from the 1940s as available at the Germanisches Nationalmuseum. The working hypothesis is that Roh significantly influenced both Neurath and Carnap and that this influence has been neglected because Roh remained a defender of the humanities (Geisteswissenschaften) after 1930 while Neurath and Carnap (who both earlier had been sympathetic to an implementation of the humanities in the context of their vision of unified science) rejected that notion. The aforementioned philosophical writings of Roh's are extremely important for that task, because they show a philosophical attitude quite similar to Carnap (e.g., with respect to values), although Roh remained a defender of the humanities and therefore did not share the reductionist aspects of physicalism.

Schlick and Wittgenstein: The Theory of Affirmations Revisited

Uebel Thomas
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This talk will investigate whether consideration of the philosophical relationship between Moritz Schlick and Ludwig Wittgenstein may allow for the redemption of Schlick's mid-1930s theory of affirmations — albeit for the price of removing him from the philosophy of science narrowly understood.

Viewed from the perspective of the epistemology of science, Schlick's theory was a clear failure. Affirmations were meant to be observation statements not identical with the protocol statements recorded by scientists but instead were conceived as incorrigible reports where understanding of sense coincided with recognition of truth. Schlick was unable to resolve the tension between the subjective certainty they provided and the objective legitimation of scientific knowledge claims they aimed for. Interpreters either rejected the theory wholesale or saved only part of it by discarding another.

The alternative reading explored here starts from noting, first, that both the early and the late Schlick accepted that there existed certain foundations for human knowledge and, second, that for the first few years since his return to philosophy in 1928 Wittgenstein's thought also centered largely on what we could not be mistaken about, on immediate experience, and its relation to human discourse generally. On the basis of Wittgenstein's notebooks and recent important archive work I will try to determine both when and which of the relevant intermediate insights on the road to his mature views were communicated to Schlick, explore how Schlick's affirmations fit with them and whether this can make better sense of them. I will argue that Schlick was encouraged to recast his earlier engagement with skepticism in terms of what he took to be Wittgenstein's new views and that, while remaining ultimately unsuccessful, Schlick's affirmations gain a certain plausibility in this light.

Cassirer, Kaila, and "Helsinki Realism"

Neuber Matthias
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In 1910, Ernst Cassirer published his influential monograph Substanzbegriff und Funktionsbegriff. In that book, Cassirer argued for an 'invariantist' conception of objectivity. According to this theory, scientific statements and laws are the more objective the more invariant they are. As an example, Cassirer in his 1921 "Zur Einsteinschen Relativitätstheorie" discussed the principle of general covariance as the most objective – since it's the most invariant – principle of General Relativity. Programmatically, he intended to argue for what he called "logical idealism." Interestingly enough, Eino Kaila, implicitly relying on Cassirer, argued for an invariantist conception of objectivity as well. However, his aim was not to strengthen idealism, but rather what he called "critical realism." His case in point was the theory of measurement that, in his opinion, could only be interpreted in realistic terms. This Kailaian conception of the 1930s and 1940s, in turn, was the smoking gun for the representatives of "Helsinki Realism." Especially Raimo Tuomela (1973) and Ilkka Niiniluoto (1999) attempted in their respective writings at defending a "critical scientific realism" that they initially intended as an answer to C.G. Hempel's "Theoretician's Dilemma" (1958). Yet although very close in spirit to Kailaian critical realism, both Tuomela and Niiniluoto eventually left open the question of their ontological commitment. As will be argued in the paper, Kaila's original – measurement-based – 'invariantism' is capable of bridging this gap. In short, it's invariant structures that are detected and objectively determined by executing measurements. Accordingly, the physically "real" is to be equated with (mind-independent) invariant measurable structures and thus conceptualized within a naturalistic setting. The resulting position may be called 'metrological structural realism.' By adopting this position, Helsinki Realism can be defended against both scientific antirealism and metaphysical realism. On the whole, the impact of Kaila's philosophical point of view will be accorded greater detail.

Revisiting Lakatos's Criticism of Carnapian Inductive Logic

Groves Teddy
Philosophy, University of Kent, Rochester, UNITED KINGDOM

In an influential paper published in 1968, Imre Lakatos argues that Carnapian inductive logic was a degenerate research programme. My talk argues that Lakatos's influential criticism was misplaced, and that a correct Lakatosian analysis of Carnapian inductive logic renders it progressive, rather than degenerate.

The talk begins by setting Lakatos's criticism in its historical context. I explain the circumstances in which Lakatos's critical essay first appeared, trace its influence and present relevant archival material which, I believe, has not yet received proper scholarly attention.

I then summarise Lakatos's criticism, arguing that it was misplaced. Lakatos's central argument assumes that early Carnapian inductive logic was committed to identifying objectively given degrees of partial entailment between propositions. I present evidence in the from of quotations from early Carnap which shows that this assumption was incorrect: early Carnapian inductive logic in fact sought merely to codify actually existing patterns of inductive reasoning, rather than to reveal objectively given partial entailment relationships.

Next I analyse the history of Carnapian inductive logic according to Lakatos's `methodology of scientific research programmes'. I conclude that Carnapian inductive logic was theoretically progressive, had heuristic power and showed signs of empirical progress.

Finally I assess my argument's significance to contemporary discourse in philosophy and the history of philosophy. From a historical point of view, I argue that many accounts of Carnapian inductive logic, which broadly agree with Lakatos, need to be revised. On a more substantive level, to the extent that Lakatos's methodology is sound, my argument improves the standing of Carnapian inductive logic and Carnap's method of explication.

B5.3 HISTORICAL ASPECTS IN THE PHILOSOPHY OF SCIENCE

Tuesday, August 4 • 14:30–16:30
Main Building, auditorium I

On Pierre Duhem's Two Epistemologies, "high" & "low"

Patapievici Horia-Roman
Philosophy, University of Bucharest, Bucharest, ROMANIA

In the literature, Pierre Duhem's epistemology is habitually deduced from his works on the philosophy of science (La Théorie physique: son objet et sa structure, 1906; ΣΩΖΕΙΝ ΤΑ ΦΑΙΝΟΜΕΝΑ. Essai sur la notion de théorie physique de Platon à Galilée, 1908). One can give reasons that, in his works on the history of science (Études sur Léonard de Vinci, 3 vols., 1906-1913) and Le Système du Monde, 10 vols., 1913-1959), Duhem uses as his working epistemology a richer one than that described and illustrated by his actual epistemological writings. Borrowing from the classic christology model (high christology & low christology), I refer to Duhem's two epistemologies as "high" and "low" epistemology. I demonstrate that Duhem's continuitism only refers to the poor or "low" epistemology: in the rich or "high" epistemology, there is a "theological revolution" (la révolution théologique) and there are instances of "birth" (naissance) of science. I also argue why Duhem did not contradict himself when suggesting two different dates for the "birth" of modern natural science. I show that, in the "high" epistemology, the traditional conflict between internalism and externalism is far weaker. The point of view this article proposes is that, in Duhem's work as an epistemologist and historian of science, there are two epistemologies at play: a theoretical, conscious and explicit epistemology (the low epistemology) and a working, implicit and practical epistemology (the high epistemology). This epistemological "dualism", thus, explains and solves most of the contradictions or complications he has been reproached.

Thomas Kuhn's Changing Conception of the External World

Bozkurt Erkan
Philosophy, Ege University, Izmir, TURKEY

Thomas Kuhn, in his famous treatise The Structure of Scientific Revolutions which is about the scientific enterprise and its historical change, distinguished between two meanings of the world concept. The first meaning, is the "perceived world" which scientists have direct access through their immediate experiences with their eyes and instruments. That world is shaped by the dominant paradigm of a mature field and it is subject to change through subsequent paradigm changes. The second meaning refers to the mind-independent, immutable external world which scientists have no direct access whatsoever. In order to explain how supporters of different paradigms perceive the world differently, Kuhn proposed a theory of perception which specifies the contents of these two worlds. The first consists of the stimuli that impinge on our senses and the other consists of the sensations derived from those stimuli. According to Kuhn, neuro-cerebral mechanism of individuals in the stimulus to sensation route is conditioned by their common biological phylogeny and programmed further by their socialization in respective communities through scientific practice. So, as a result, scientists belonging to communities with different paradigms experience the world differently. However, through the end of his career, Kuhn leaves this conception of the external world for an evolutionary conception of ecological niche. According to this conception, Kuhn replaces the one, big, mind-independent external world with variety of niches which are mind or culture dependent. However, these niches are also solid, substantive and resistant to arbitrary hypotheses which do not obey to their behaviors. In this presentation, I will discuss where this move in Kuhn's conception refers to in the realism anti-realism debates regarding the existence and knowledge of the external world. Further, I will argue that this position brings a naturalistic theory of scientific knowledge which may be viewed as an evolutionary cognitive approach.

CONTRIBUTED PAPERS / B5.3 HISTORICAL ASPECTS IN THE PHILOSOPHY OF SCIENCE

Pragmatic Realism, Idealism, and Pluralism: A Rescherian Balance?

Pihlström Sami
Helsinki Collegium for Advanced Studies, University of Helsinki, University of Helsinki, FINLAND

One of the most remarkable features of the kind of pragmatism committed to advancing scientific rationality and objectivity that Nicholas Rescher has defended for decades is its attempt to maintain a balance of a number of philosophical ideas that are often in tension with each other. Rescherian pragmatism is realistic (even metaphysically realistic), but it is also idealistic (in the sense of "conceptual idealism" or "pragmatic idealism"); moreover, its realism and objectivism do not seem to preclude a pluralistic conception of a variety of different perspectives (or "systems", "conceptual schemes") we may employ for conceptually categorizing reality. These views are highly relevant to the general realism discussion in the philosophy of science, to which Rescher has been a key contributor for decades.

Starting from some of Rescher's own formulations of these and related ideas – spanning several decades of systematic philosophical work, from Conceptual Pragmatism (1973) via A System of Pragmatic Idealism (1992- 94) to Realistic Pragmatism (2000) and beyond – this paper will critically examine the Rescherian attempt to overcome the potential conflicts between realism, idealism, and pluralism. I will, inevitably moving significantly beyond Rescher's own position and its historical development, seek to articulate a pragmatist approach whose key aim is a critical balance of these allegedly mutually incompatible philosophical commitments. I will suggest that the kind of holistic pragmatism defended by Morton White (who, like Rescher, is a somewhat neglected pragmatist thinker), since his Toward Reunion in Philosophy (1956), is helpful, albeit not unproblematic, in integrating pragmatic realism, idealism, and pluralism. I will argue that the Rescherian type of pragmatic realism-cum-idealism, even when enriched by White's holism, needs to take seriously the Kantian (and, therefore, transcendentally idealistic) background of pragmatism, pluralistically reinterpreted.

The Dynamic, Relative or Pragmatic A Priori: How philosophers of science have used constitutive elements of science to model conceptual change

Stump David
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In science, there are principles and theories that are taken for granted before empirical inquiry can begin. While these theories and principles may have been confirmed empirically, some fundamental principles or laws and all of the mathematics upon which science depends have a more problematic basis, since these principles are very difficult to conceive of as being empirically grounded. Thus, some of the principles and all of the mathematics appear to be a priori knowledge, serving as constitutive elements in science that play a special role in scientific theories, given that they are necessary preconditions to further inquiry. In order to account for conceptual change in science, Friedman revived Reichenbach's idea of a dynamic a priori, showing that conceptual revolutions occur in science when there is a change in what had been taken to be a priori knowledge. We find similar alternative views of the a priori in Cassirer, Lewis, Pap, Kuhn and Hacking. However, the term 'a priori' as misleading given that what is functioning as a priori knowledge is not actually a priori at all in the traditional sense. The crucial point is that we have various theories of the constitutive elements in science, Kant's, in which the constitutive elements really are a priori, i. e. necessary and fixed, and others, in which the constitutive elements are not fixed, so that we can understand conceptual change in science as changes in the constitutive elements. I set out and defend a special role for constitutive elements in science, a pragmatic view that there are principles and theories that are necessary preconditions for the possibility of a science, but which stays closer to naturalism than the neo-Kantian position advocated by Friedman, who also defends a role for constitutive elements in opposition to Quine's holism.

B5.4 HISTORICAL ASPECTS IN THE PHILOSOPHY OF SCIENCE

Thursday, August 6 • 11:00–13:00
Main Building, Room 17

The reception of Ludwik Fleck's theory of thought styles and thought collectives in English.

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The story of H. Reichenbach's footnote (1938) and the fact that T.S. Kuhn mentioned Fleck's German book ("Entstehung ung Entwicklung einer wissenschaftliche Tatsache") in the foreword to "The Structure of Scientific Revolutions" (1962) is quite well known. What happened after the publication of American translation of Fleck's book (1979) hasn't yet been described. And the bibliography of the reception of Ludwik Fleck's theory in English consists of over 300 entries. Surprisingly only around 30% of authors who write on Fleck in English come from English speaking countries (around 10% - Poland, around 25% - German speaking countries, around 35% - others). Although more or less a half of Fleck's theoretical legacy is written in Polish, those who come from English speaking countries and write on Fleck in English in 70% cite only the American translation of Fleck's German book (and English translations of Fleck's Polish papers are available). The question why Fleck's theory of thought styles and thought collectives was recognized so late was raised by many authors. I would like to raise the question how it is recognized nowadays in English language with special attention to the problems of translation and trace few examples of Fleck's original expressions, it's English translation and the influence of these translations on the reception in English.

Reinvigorating Hanson's patterns of discovery

Paavola Sami
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Matthew D. Lund (2010) has recently written a book on N. R. Hanson's history and philosophy of science. Hanson is often treated as an important precursor of many important ideas in the late 20th century philosophy of science; like the theory-ladenness of observation, discussions on logic of discovery, or a close relationship between history and philosophy of science. Still, as Lund points out, Hanson's more elaborate reading has not received philosophical attention it deserves. One way of seeing Hanson has been through the Kuhnian framework, that is, as a basis of what Kuhn developed further. This has left the analysis of Hanson's ideas incomplete.

In my presentation I analyze critically Lund's interpretation on Hanson's philosophy. One central notion is that of intelligibility. Scientists are creating new "patterns" while struggling to make sense of the object of their research. As Lund points out both Hanson and Kuhn were modeling the creation of new conceptual frameworks. But unlike Kuhn, Hanson thought that this creation is a rationally appraisable activity.

I maintain that in his many ways excellent treatment, Lund is missing one central aspect of Hanson's philosophy. Lund discusses abductive inference only in passing, and he is not seeing the meaning and the potential of abduction for making sense of intelligibility. Hanson's ideas on abduction as a logic of discovery can be defended and developed further. Methodology still often emphasizes the testing of hypoheses and test implications while abduction gives means of reasoning "backwards", from consequences to hypothetical causes. This bias can be seen in Lund's analysis also. There are also interesting parallels between abduction and Kuhn's description of paradigm shifts which gives means of analyzing Kuhn's implicit "logic of discovery".

References: Lund, M. D. (2010) N. R. Hanson. Observation, Discovery, and Scientific Change. New York: Humanity Books.

Lakatos, Rational Reconstruction and Comparative Historiography

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In this talk my aim is to show that (1) an aspect of Imre Lakatos's philosophy has been largely ignored in previous discussions and that (2) this omitted aspect has great potential to contribute to the philosophy of the historiography of science. More specifically, it may provide an answer to the question of whether and how historiographical data can be used to support and compare different 'philosophies of science'. In other words, I will outline a valuable core of Lakatos's philosophy of historiography and then update it to meet the requirements of the contemporary history and philosophy of science.

The plan is as follows. First I explain the positive features of Lakatos's philosophy of historiography, which are: (i) highlighting of hierarchies of historical interpretation, (ii) non-realism and (iii) comparative historiography of science using an epistemic value (of rationality) for comparisons. In the second section of this essay I discuss potential problems in Lakatos. They are: (i) Lakatos's reference to 'actual histories' that seemingly contradicts non-realism, (ii) utopianism due to exaggerating the rationality of history and (iii) distortion of the history of science because of Lakatos's normative ambitions. The last part is devoted for updating Lakatos's programme to answer the needs of contemporary history and philosophy of science. First, (i) it is necessary to bring new 'methodologies' or 'philosophies of science' into consideration, such as scientific realism and Latourian actor- network analysis. (ii) Another issue that needs updating is criteria to be used in comparative evaluation. I consider what other values beside rationality could be used in comparisons. Finally, (iii) I will mention briefly an example of how Lakatosian comparative historiography of science works in its updated mode.

Thomas Kuhn and the rationality of theory choice.

Carvalho Eros
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In this communication, I try to articulate and clarify the role of the epistemic authority of experts in Kuhn's explanation for the transition process between rival paradigms in the scienti?c revolutionary period. If science progresses, that process should contribute to the attainment of the cognitive aim of science, namely, the articulation of paradigms increasingly successful at the resolution of problems. In virtue of the semantic and methodological incommensurability between rival paradigms, it is not easy to sustain that the winner paradigm is superior in relation to the aim of science. Furthermore, according to Kuhn, scientists choose one paradigm instead of another based on subjective reasons. If the debate between rival paradigms ends that way, then it seems that science moves irrationally. Against this conclusion, we could say that the individual choice can be irrational if it doesn't affect the epistemic rationality of the process of changing from one paradigm to another. Given that a paradigm needs supporters in order to be developed, it is good that some scientists give support to a new paradigm based on subjective reasons. Otherwise, scientific revolutions would never happen. Nevertheless, even when we have two well developed incommensurable paradigms, the scientist's comparative judgment that one paradigm is better than the other would not be based on common evidence, according to Kuhn. So, it seems that the threat of irrationality comes back. It is hard to see this process as rational and attaining the cognitive aim of science. In order to avoid this conclusion, I will argue that we should appreciate the kind of epistemic authority that is granted to the scientist by our society in the revolutionary period. The mistake of Kuhn was to emphasize and clarify insufficiently the role of the epistemic authority of experts; his critics failed for ignoring it altogether.

B5.5 HISTORICAL ASPECTS IN THE PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 17:00–18:30
Main Building, Room 5

Which Intuition for Intuitionism?

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The founder of intuitionism, L.E.J. Brouwer, claimed that mathematics should be grounded on human intellect and not on paper. Intuition, more precisely, is considered as the component of human intellect on which mathematics is to be built. But what exactly is this intuition? And how does it play such a role for mathematics? In a lecture held in 1912, Brouwer explained that his own intuitionism (then called "neo-intuitionism") derives from that of Kant's. Kant's philosophy of mathematics, as exposed in the Critique of Pure Reason, gives indeed an important role to the "pure intuitions" that are time and space. According to Brouwer, neo-intuitionism has to differ from Kant's intuitionism because the development of non-Euclidean geometries has undermined the Kantian statement that pure intuition of space serves as a foundation for geometry. Therefore, in order to save intuitionism, Brouwer proposed to abandon space as a pure intuition and give a more important role to time. Brouwer's intuitionism appears to be Kantian intuitionism without space as a pure intuition, and consequently the answer to the question of the nature and role of intuition should be found in Kantian philosophy. This paper will examine the value and the scope of this adjustment to Kant's philosophy of mathematics. It seems indeed to be based on a common but incorrect reading of Kant's Transcendental Aesthetic, according to which space and time have analogous functions as pure intuitions. Applied to the philosophy of mathematics, this reading suggests that geometry is based on space and arithmetic on time. It will be argued that, on the contrary, the Kantian conception maintains that arithmetic depends not only on time but also on space. This raises the question of whether or not Brouwer's intuitionism can consistently be endorsed without appealing to space, and, if so, at what cost.

Operationalism and realism in Soviet theoretical physics

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Main discussions in the philosophy of science over the last fifty years held under the banner "Realismantirealism debate". Sometimes it seems that producing new forms of realism and antirealism and proposing new sophisticated arguments "pro" and "contra" give to the philosophy of science a tinge of scholasticism. At the same time the philosophical and methodological position of the working scientist often appears to be eclectic because his aim is to solve concrete theoretical and experimental problems, but not to constitute new philosophical conception. I attempt to find out reasons of particular operationalistic and realistic interpretations of scientific concepts in soviet theoretical physics. Operationalism in the philosophy of science traditionally is associated with the P. Bridgman's ideas. However, specific kind of operationalism was developed in soviet theoretical physics by L.I. Mandelshtam. He was founder of the scientific school presented by I.E. Tamm, A.A. Andronov, M.A. Leontovich, S.E. Haikin, A.A. Vitt. L.I. Mandelshtam's key methodological ideas have received further support through the works of this physicists. Both P. Bridgman and L.I. Mandelshtam were influenced by Einshtein's critique of the "simultaneity" but their kinds of operationalism diverge on key issues. It is particularly important that L.I. Mandelshtam attempted to combine operationalism with intersubjective understanding of "operation" and realistic interpretation of physical theory while P. Bridgman stayed closer to subjectivism and instrumentalism. V.A. Fock in 1930-th defended Copenhagen interpretation of quantum mechanics, but he was strongly against instrumentalism. In order to avoid instrumentalism V.A. Fock developed realistic interpretation of quantum mechanics. It was motivated by his philosophical materialistic position which was not just the curtsey to the official soviet scientific fashion.

C1

C1.1 PHILOSOPHY OF THE FORMAL SCIENCES

Tuesday, August 4 • 11:00–13:00
Main Building, Room 10

Penelope Maddy between realism and naturalism

Kvasz Ladislav
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In her Realism in Mathematics Maddy defended a realist position in philosophy of mathematics. After criticism from Balaguer, Carson, Lavine, and Riskin she gave up realism and turned to Naturalism in Mathematics. In the paper I will reformulate Maddy's realistic position by stressing the instrumental aspect of mathematics. Mathematical reality is discovered by means of instruments of symbolic representation. These instruments are human creations and as such they change in time. By bringing in the historical dimension we obtain a strong tool for defence of the realist position in the philosophy of mathematics against the above mentioned criticism. We can distinguish different kinds of instruments of symbolic representation, such as the different positional systems in arithmetic, the symbolic notation in linear or polynomial algebra, the functional symbolism in the differential and integral calculus, and the logical symbolism in predicate calculus. By drawing on an analogy between these representational instruments in mathematics and measurement instruments in physics we can refine Maddy's position by grounding intuition in instrumental practice. By introducing several instrumental practices it becomes possible to develop the foundation of a later instrumental practice (say that of the calculus) by means of an earlier one (say arithmetic). In this way we can interpret the sets as objects that are situated not in the space of our immediate perception, as Maddy did (and Carson objected). We situate in that space the objects of elementary arithmetic. Then by ascending the historical sequence of representational instruments we pass through the universes of algebra, calculus and logic to the universe of set theory. These universes are nested, the earlier ones are embedded in the later ones. And by means of this embedding sets obtain realistic status.

The Subject of Mathematics

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There are two possible answers to a question concerning the subject of mathematics: 1. Mathematical reality exists objectively (Penrose, who stands behind this resolution, discusses a Platonic world of mathematical ideas); and 2. Mathematical reality is constructed by mathematicians. Both of these positions face some essential and intractable difficulties.

Regarding the first position, one has to confront the problem of the truthfulness of mathematical statements. Although Tarski indicated the way to define the notion of truth for formal languages, he did not do so for the criterion of truth. It is even possible to prove that, for richer languages, such a criterion cannot exist. Thus, we have no access to a "Platonian world of ideas."

In the second position it is mathematical language that creates mathematical reality, so utterances must be "well done" to comprise successful performatives (see works of John L. Austin). The primary condition is consistency. Kurt Gödel demonstrated the complexity of this problem in detail.

The challenge to both of these positions is the preposterous effectiveness of mathematics. It is hard to explain why the world of ideas or constructions of mathematicians matches up so splendidly with empirical reality. An attempt to understand this phenomenon sends us back to the emergence of mathematics, which first involved trading and commercial exchanges, measurements of land, navigation, etc. It also reflects on our ability to perceive a uniform structure within a diversity of phonemes. The development of mathematics, then, does not depend on creating any construction of or penetration into a Platonian world of ideas, but rather on seeking an Aristotelian form in the objects and patterns we pursue in reality in innumerable ways.

This suggests a third position in the debate on the nature of mathematics, alongside those of constructivism and Platonism. We may call this third position, "Aristotelism."

Why believe there are infinite sets?

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The axiom of infinity – the statement that there is an infinite set - is not justified. This should disturb those who believe both that there are infinite sets and that set theory should be foundational of mathematics.

Why should we want a justification for it? In the wake of Hilbert's program, one might call "sets" any objects that satisfy a list of set-theoretic axioms (von Neumann 1925). Fictionalists may deny there really are any sets to make the axiom true. Brouwer (1913) suggested the infinity and sethood of the natural numbers are given directly in intuition. Whatever their general merits, these positions are dubious when it comes to the axiom of infinity, for reasons anticipated by Dedekind (1888), Russell (1919), and Skolem (1922). So the axiom stands in need of justification.

How could one try to justify the axiom of infinity? P. Maddy distinguishes extrinsic from intrinsic justifications. As for extrinsic justifications, an enhanced indispensability argument (Baker 2005) cannot be run for the axiom itself, nor, I argue, for set theory more generally. Moreover, the foundational role of set theory (Boolos 1998) or its centrality to mathematical practice (Quine 1951) are assumptions that stand in need of justification themselves. And believing the universe of sets is maximal - anything short of contradition (Zermelo 1908) – itself requires justification. Intrinsic justifications are more interesting. One cannot follow Frege (1893) in supposing that, because there are consistent concepts of infinity, infinite sets do exist, because of Russell's paradox. Nor can one follow Boolos (1971) in deducing one axiom of infinity (there is a Dedekind-algebra) from an iterative conception of sets that itself contains an axiom of infinity, albeit a different one (there is a limit-level). Deducing existence from concept fails.

So explicit arguments are called for to justify the axiom. Dedekind's foundational study (1888) provides the only explicit arguments I am aware of. First, Dedekind argued that the possible objects of thought form a Dedekind-algebra. Misplaced charges of psychologism aside (Potter 2004), the assumption that the operation "thinking about" is closed over the set of possible objects of thought needs to be justified.

Second, Dedekind wished to represent arithmetic in set theory. Finite arithmetic (Cohen 1966) is sufficient to capture natural and rational arithmetic. Real numbers cannot be so represented (Russell 1908), but why believe real numbers have sets as counterparts? One might say: if finite numbers exist, then by pairing and extensionality their singletons exist, hence by union an ω-large set exists. All this proves is that union is not closed over finite sets. Assuming there were an ω-large set, this would form a Dedekind-algebra only if the axiom of denumerable choice were true (Cohen 1966), and this axiom is considerably more controversial than the axiom of infinity (Skolem 1922).

Perhaps there are other arguments yet. But Russell's early discussions (1908,1919) strongly suggest that the axiom of infinity both needs a justification, and lacks one. We should pay heed to Russell's sentiment.

Is There an Objective Account of Mathematical Depth?

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Maddy has argued that there are objective facts of mathematical depth that constrain appropriate axiom choice in mathematics, and which undergird a version of mathematical realism that is compatible with her particular version of philosophical naturalism (Second Philosophy). Perhaps surprisingly given its importance in her account of mathematics, she leaves the concept of mathematical depth largely unanalyzed. What little she does say about the concept by way of linking mathematical depth to fruitfulness indeed seems to pose a threat to the idea that it is an objective matter. After noting the problem here, the paper takes up how mathematical depth might be further elaborated so as to maintain the claim of objectivity. The suggestion considered in some detail is that mathematical depth is associated with general explanatory virtues. It is observed, though, that even if explanation is identified with mathematical depth, serious challenges arise for Maddy's objectivist. These involve spelling out an account of mathematical explanation that will yield a privileged collection of axioms, and defending the account as objective on appropriate naturalistic grounds. I argue that while there are prospects for understanding mathematical explanation in objective terms, the varied nature of mathematical explanations calls into question whether linking mathematical explanation and mathematical depth supports the idea of a privileged set of axioms. Finally, I point to a tension between the basis for the objectivity of theories of mathematical explanation suggested in the paper and Maddy's version of naturalism.

C1.2 PHILOSOPHY OF THE FORMAL SCIENCES

Tuesday, August 4 • 17:00–19:00
Main Building, Room 10

Idea of triple determination of mathematical reality

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The paper presents the step toward synthesis of mathematical realism and antirealism in the form of emergence of 'third', medium line based upon the idea of triple determination of mathematical reality (mathematical objects). We put forward the idea that the process in which most closely intertwined mechanisms of representation (external stimuli), its bodily organization, namely brain structures (internal stimuli) along with historical conditioning and socio-cultural milieu have been forming standard (normative like) actions with abstract mathematical objects.

Key words: realism, Platonism, antirealism, nominalism in mathematics, 'third line', triple determination of logico-mathematical objects.

Goodman and Mathematics

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My purpose is to to show that the study of the aesthetic properties of mathematics provides the philosophy of mathematics with a relevant analytical key. More precisely, I will show what the use of Goodman's symptomatology can contribute to an analysis of mathematical reasoning. In 1968, Goodman's Languages of Art was published (Nelson Goodman, 1968, Languages of Art, Indianapolis: Hackett), in which work the author develops a symptomatological approach to the aesthetic workings of symbolic systems. The thesis that I would like to present purports to substantiate the validity of Goodman's analysis of mathematics.

Indeed, in Goodman's work, the analysis of symbolization is supported by an analysis of reference. The purpose of this analysis is not to provide an ontological explanation of reference – why such and such a predicate applies to such and such an object ? – but to pin down the various types of reference. This ontological parsimony is especially worthwhile where the aesthetic analysis of mathematics is concerned, since it provides a glimpse of what results might be obtained independently from any ontologically restrictive conception of mathematics.

I would say that beyond offering a means of showcasing the aesthetic operations of mathematics and understanding their cognitive role, the goodmanian analysis of mathematics' main contribution is to account for certain phases and connections in mathematical reasoning that are inaccessible to standard logic. In particular, exemplification makes it possible to study the role of a mathematical symbol in the context of a chain of reasoning from the standpoint of its intension, whereas standard logic would only take its extension into account.

In this regard, studying the kinship between mathematics and aesthetics offers some hope of furnishing us with a number of elements of explanation as to the possible relevance of aesthetics to the philosophy or epistemology of mathematics.

Realism and instrumentalism in mathematics

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The debate around realism in mathematics has received much attention, with the two opposite stances, Platonism, which supports the view that abstract entities involved in mathematical theories do exist (Quine, Godel, etc.), and Nominalism (Field, etc.), which negates all the way the existence of mathematical entities. In the debate around realism in mathematics, the Quine-Putnam indispensability argument play an important role being the only argument not mathematical in nature. But this argument assert the existence of mathematical objects without any commitment to the nature of mathematical entities and to their scope inside scientific theory: just having a role is sufficient for granting existence.

On this grounds, I take a compromise view in between Quine's and Maddy's naturalisms, supporting Quinean continuity between science and philosophy and a revisited confirmational holism, where only some mathematical entities have ontological commitment. The cogency of inference from indispensability to mathematical existence is investigated. This calls into question issues concerning what do we mean by "indispensable" entities, and the way nature exhibits certain mathematical entities at some levels of organization. In a word, ontological commitments are levels-oriented. For example, atoms and molecules exhibits some arithmetical features, showed by flowers and animals at a higher level. We may say that nature is programmed to exhibit regularly some behaviours, and mathematical objects are part of its intrinsic features, the result of the working, self-organizing, nature.

On the other horn, for example, there is real analysis, which is ubiquitous in physical sciences, but it cannot have an ontological commitment being an idealization of world's behaviour.

A naturalized approach to indispensability

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Philosophical work on indispensability arguments for mathematical realism has recently focused on the thesis of the essential indispensability of mathematics to scientific explanation.. I argue, first, that consensus regarding the existence of genuine mathematical explanations of scientific facts may be hard to obtain by way of philosophical discussions of case studies. In a nutschell, the argument is that norms that govern one's philosophical judgment about the grade of an explanation are not independent of the norms that guide her ontological judgement -it is to be expected that, e.g., a nominalist will never abide by the force of a realist's example as she will tend to fault the proposed explanation for using surragorate inexistent objects or fictional discourse...

I shall then make a plea for an entirely different sort of evidence to be brought to the debate. In a radical naturalist tradition of deference to science, I will suggest that the normative question of the indispensability of mathematics in explanations can be replaced by an empirical question: the question whether the notion of a mathematical scientific explanation receives substantial credit in the scientific community. For the less radical, who holds to the idea that the philosopher can be right against the scientific community regarding what counts as a scientific explanation, the empirical question does not supersede the normative one, but still, even in that case, I argue that minimal naturalism commands that in addressing the normative question, the philosopher should grant that the charge is upon him to prove that the epistemological attitude empirically found to be that of the current scientific community, if different from the one he recommends, is wrong. I shall then sketch a way to deal with what I call the 'empirical question of indispensability' using scientometrics and say more about what the benefits of a naturalized approach to indispensability can be in the debate over indispensability arguments.

C1.3 PHILOSOPHY OF THE FORMAL SCIENCES

Wednesday, August 5 • 11:00–13:00
Main Building, Room 10

Composition, Identity and Emergence

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Composition is Identity (CAI) is the thesis that a whole is, strict and literally, identical to its parts, considered collectively. McDaniel (2008) argues against CAI in that it prohibits emergent properties. Recently Sider (2014) exploited the resources of plural logic and extensional mereology to undermine McDaniel's argument. He shows that CAI identifies extensionally equivalent pluralities –he calls it the Collapse Principle (CP)- and then shows how this identification rescues CAI from the emergentist argument. In this paper I first give a new generalized version of both the arguments. It is more general in that it does not presuppose an atomistic mereology. I then go on to argue that the consequences of CP are rather radical. It entails mereological nihilism (MN), the view that there are only mereological atoms. In a nutshell the argument is the following. CP entails duplication (D): every part of a given mereological fusion is a duplicate of such a fusion. D in turn entails MN for there are no composite objects that can be a duplicate of any of their proper parts. I finally show that, given a mild assumption about property instantiation, namely that there are no un-instantiated properties, this argument entails that CAI and emergent properties are incompatible after all.

The arguments make abundant use of minimal plural logic and extensional mereology.

Appendix. Formal Framework

Let $x \prec y$ = "x is part of y"; Xy = "y is one of the x"; $x \triangleq y =$ x is a duplicate of y", where x stands for a singular variable and X for a plural one. Define proper part ($x \prec\prec y$), overlap ($O(x, y)$ and fusion ($xFuY$) according to standard extensional mereology. Then:

CAI: $\forall x \forall Y(xFuY \rightarrow x = Y)$

CP: $\forall X \forall x(xFuX \rightarrow \forall y(Xy \leftrightarrow y \prec x))$

D: $\forall X \forall x(xFuX \rightarrow (\forall y(Xy) \rightarrow x \triangleq y))$

MN: $\forall x \sim \exists y(y \prec\prec x)$

(1) CAI $\rightarrow$ CP

(2) CP $\rightarrow$ D

(3) D$\rightarrow$ MN

(4) CAI$\rightarrow$ MN

On the significance of categoricity arguments

Ludusan Adrian
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The purpose of my paper is to assess the philosophical significance of categoricity argumentsin the broader context of the philosophy of mathematics. With respect to this purpose we analyze five main proposals regarding the philosophical significance of categoricity: 1) that the categoricity of a theory shows there is a unique structure which is the intended model of that theory, 2) that the categoricity of a theory is a marker for the theory's successful axiomatization, i. e. completeness of axiomatization with regard to its subject matter, 3) that categoricity arguments give thrust to semantic realism, that is, ensures that the sentences of a categorical theory have a determinate truth value, 4) that the categoricity of a theory is a useful concept in classifying theories as algebraic and non-algebraic, and 5) that the categoricity of a theory enables to communicate

mathematics: two mathematicians accepting the same axioms of a categorical theory can be sure that they are talking about the same structure modulo isomorphism. I will examine several proofs of categoricity theorems in different settings (first order logic and second order logic) in order to highlight the essential components involved in the proofs as well as some substantial philosophical positions assumed in the process. Shapiro's (1991) modern reconstruction of Dedekind's (1888) proof of the categoricity of Peano arithmetic will be a focal point of the discussion, contrasted with categoricity proofs conducted in weaker systems. In the light of this clarifying discussion, I will analyze whether categoricity arguments fulfills some of the above proposals. Also, I will assess the relevance of the categoricity arguments for the ante-rem structuralism. I'll show that categoricity arguments fails to fulfill, at least, proposal 1) and 3) and in consequence their relevance for ante-rem structuralism is highly problematic.

Proper Classes, Forcing Extensions, and Universism; Understanding the role of simulation in mathematics

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Universism in Set Theory, the view that there is a single, unique, maximal interpretation of set-theoretic discourse has come under a good deal of scrutiny over the last decade. Two of the strongest arguments that have been presented against the view are its susceptibility to revenge paradoxes and inability to interpret forcing extensions of V. In this paper I analyse the dialectic of the debate and argue that Universist solutions depend crucially on intuitions regarding the philosophical significance of simulation in mathematics. My strategy is as follows: Section 1 provides a characterisation of Universism and situates the view within contemporary philosophy of mathematics. Section 2 presents two kinds of revenge paradoxes that have been generated for the Universist. The first concerns ordinals of apparent length greater than On. I present this in two different ways; an intuitive problem and the issue as it arises in mouse theory (where one way to understand this practice is as iterations of the construction of L past On). The second revenge problem is the issue of being able to give semantic content to the claim that for any class C, there are `more' subclasses of C than members of C. Section 3 presents a different issue, the apparent inability of the Universist to interpret forcing extensions of V. Section 4 argues that both difficulties depend for the Universist on the claim that various forms of simulation of mathematical entities entails the existence of said entities. Section 5 then provides reasons to doubt the claim that simulation implies existence in the case of mathematics, in particular with respect to infinitesimals and non-well-founded sets.

It is concluded that if these criticisms are to be powerful against the Universist's position, a better account of the nature and significance of mathematical simulation is required.

Fixed Point Models for Theories of Properties and Classes

Restall Greg
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There is a vibrant (but minority) community among philosophical logicians seeking to resolve the paradoxes of classes, properties and truth by way of adopting some non-classical logic in which trivialising paradoxical arguments are not valid. There is also a long tradition in theoretical computer science—going back to Dana Scott's fixed point model of the lambda calculus—of constructions allowing for various fixed points.

In this paper, I will bring these traditions closer together, to show how these model constructions can shed light on what we could hope for in a non-trivial model of a theory for classes, properties or truth featuring fixed points.

C1.4 PHILOSOPHY OF THE FORMAL SCIENCES

Wednesday, August 5 • 14:30–16:30
Main Building, Room 10

Mathematics in Structural Explanations

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The debate over the explanatory power of mathematics, initially motivated by the indispensability argument for the existence of mathematical objects, has focused on the question whether mathematics does some explanatory work in a scientific explanation. My goal in this paper is to investigate what sorts of explanatory work mathematics does in scientific explanations and how mathematics makes its explanatory contribution to those explanations. In order to do this, first, I briefly recount the enhanced indispensability argument (EIA) (Baker 2005, 2009), paying particular attention to why the core case in EIA, "the life-cycle period of cicadas measured in years is prime," is not an ideal case to characterize the explanatory power of mathematics. Next, I revisit a geometrical case (Leng, 2012), "it is impossible to square a circle," which is promising but not yet welldeveloped to show the explanation made by mathematics. Then I provide a novel argument for how this case can spell out the explanatory power of mathematics. Specifically, I argue that, in Leng's case, mathematics makes its explanatory contribution by two steps: (1) the original unsolvable problem in Euclidean geometry, "why is it impossible to square a circle," is successfully shifted into a solvable problem in a new algebraic theory–field theory. (2) the algebraic theory of field makes its explanatory contribution by its interpretability strength, namely that "its hierarchy of interpretability is higher than that of Euclidean geometry theory." Last, I address a potential objection to using the interpretability hierarchy to show the explanatory power of the algebraic theory of field: showing the difference of interpretability strengths between the algebraic theory of

field and the Euclidean theory is irrelevant to argue for the explanatory power of the algebraic theory of field in explaining the impossibility of squaring the circle. I argue that this objection does not work.

Keeping Pure and Applied Mathematics Together: the Role of Frege's Constraint.

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Neologicists pay much attention to Frege's Constraint [FC] (cf. Wright [2000]), the requirement that the possibility of applications of a mathematical theory should be explained by the nature the definitions of a theory assign to its objects. [FC] raises several questions:

a. what is the core requirement underlying [FC]?
b. how does [FC] fit with Frege's concerns with applications and applicability of mathematics?
c. which accounts of mathematics does [FC] privilege or rule out?

Concerning (a), I show that recent formulations of [FC] (cf. Wright [2000], Hale [2002]) are question-begging by entailing themselves a platonist, or logicist, or apriorist view of mathematics. I individuate a core requisite of [FC], and a Modest-[FC] capturing it, related not to the nature of mathematical objects but to the content a mathematical theory establishes, via its definitions, for its statements.

Concerning (b), I rehearse Frege's concerns on the relation between pure and applied mathematics, underlying three families of objections: objections to empiricists (Frege [1884][§.9]); to formalists (esp. Frege [1893-1903],

§.91, Vol. II); to Cantor's and Dedekind's definitions of the reals (esp. Frege [1893- 1903], §.159). I show that Frege's required balance (cf. Hale [2002]) between preserving the generality of mathematics and avoiding accidentality for its applications is secured by Modest-[FC], which is robust enough to support Frege's objections to opponents.

Concerning (c), I suggest that Modest-[FC], while ruling out both Frege's opponents and what neo-logicists blame as "arrogant" definitions (cf. [Hale, Wright 2001]), is fully compatible with views rival to neo-logicism, most notably Shapiro's ante rem structuralism (cf. Shapiro [2000], [2004]). [FC] is not by itself sufficient to decide between neologicist and structuralist (among others) reconstruction of mathematics. When properly understood, [FC] proves to be a promising way of keeping philosophical accounts of pure and applied mathematics together, not limited to a neologicist setting.

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State constraint system applicable to judgement adjusting

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In logical foundations of artificial intelligence, the concepts of the *state* and its change (by *actions*) are formulated in first and second order logics. As regards actions for process communications, π-calculus has been established. As a primary step to π-calculus, a logic was discussed, where formulae in the logic are definable in BNF notation: $\varphi ::= \mathrm{ff} \mid \varphi \vee \psi \mid \neg\varphi \mid \langle a\rangle\varphi$. The denotation $[\![\varphi]\!]$ of a formula φ on a transition system $\mathcal{T} = (S, A, \rightarrow)$ is defined *recursively* for a set S of states: $[\![\mathrm{ff}]\!] = \emptyset$ (the empty set), $[\![\varphi \vee \psi]\!] = [\![\varphi]\!] \cup [\![\psi]\!]$, $[\![\neg\varphi]\!] = S \setminus [\![\varphi]\!]$, $[\![\langle a\rangle\varphi]\!] = \{s \in S \mid \exists t \in S : s \xrightarrow{a} t \text{ and } t \in [\![\varphi]\!]\}$, where an expression $\langle a\rangle$ is concerning an abstract action a in A and "$\rightarrow$" is a state-transition relation. The author models a system where a formula with compound actions of the form $\langle r\rangle\varphi$ is considered with respect to forming a *set of action sequences*, which is denoted by the expression r.

In this contributed talk, the *state constraint system* of multi-process is formulated, where:

(i) the process contains states,

(ii) the state involves both *functions* (to be applied to global variables) and the rule set of actions,

(iii) the behavioral semantics contains an oracle by monitoring on which process of the (*distributed*) system is taken for each state constraint, and

(iv) state transition structures may be viewed from algebraic senses.

The state constraint system may be mostly relevant to *Abstract State Machine*. The system of this talk is, however, concretized and characteristic in the sense that:

(1) The functions constrained by a state can be defined, following functional, logic-based, styled in programming or database, object-oriented, or some other way.

(2) The state transition structure is affected by the evaluations of function applications such that the sequential and alternative structures of state transitions may be closely related to the structure of *semiring* as in *weighted automata*, applicable to judgement adjusting.

C1.5 PHILOSOPHY OF THE FORMAL SCIENCES

Saturday, August 8 • 10:00–12:00
Main Building, Room 7

"Visualisations in Mathematical Practice and Formation of New Concepts"

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The paper aims to show that mathematical practice, using visual representations, can lead to new mathematical results including the development of new mathematical concepts. The case study for supporting this claim is taken from geometric group theory. This began as an application of some geometric ideas in combinatorial group theory, but a novel geometric perspective developed in the 1980s was so fruitful in results about groups that geometric group theory acquired the status of a branch of mathematical research in its own right. The case study demonstrates that representing groups as Cayley graphs, and then representing the latter as metric spaces, facilitated studying groups by geometric methods and led to the discovery of a number of geometric properties of groups. As a result, many combinatorial problems were solved through the application of geometry. On top of that, new interesting concepts expressing the geometric properties of groups were developed. The example explains how algebraic groups can be considered as geometric objects as such and studied by geometric methods to obtain new results about groups. Finitely generated groups can be represented by their Cayley graphs, which are connected and can be equipped with a path metric. Given this metric, we can consider the Cayley graphs and therefore their groups as metric spaces. Then we can compare them with other metric spaces such as Euclidean or hyperbolic spaces, and apply geometric methods to reveal further geometric properties of the groups. This twist changes our habitual apprehension of geometric and algebraic concepts.

Can alethic arguments for consistency transmit justification?

Daniel Waxman
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How do we obtain justification in the consistency of mathematical theories? One possible answer is via alethic arguments, roughly, arguments that derive the consistency of a theory from the claim that all of its axioms are true. Such arguments can be shown to be valid when formalized in a suitable setting. But although they are formally valid, their epistemic value is not so straightforward. I examine the intuitive worry that arguments of this kind are objectionably circular, and attempt to make it precise by construing it as an accusation that they fail to transmit justification in the sense widely discussed in recent epistemology. I argue that, surprisingly, the question of whether these arguments succeed in transmitting justification depends on several prior issues in the epistemology of mathematics, but that on a wide class of plausible views it nevertheless fails.

C1.6 PHILOSOPHY OF THE FORMAL SCIENCES

Thursday, August 6 • 11:00–13:00
Main Building, Room 10

Brouwer's intuitionism: an early representational approach on the foundations of mathematics? CANCELLED

Del Vecchio Junior Jacintho,
Archives Henri Poincaré, Université de Lorraine, Cajamar, BRAZIL

Substantial part of contemporary philosophy of mathematics is still fulfilled by discussions which oppose realism and anti-realism concerning the nature of mathematical objects. The main problematic consequences of these positions are well known: from the realist point of view, there are great difficulties to explain how the representation of non-mental entities can be perfectly expressed by conceptual terms that correspond to them; on the other hand, anti-realism must deal with the apparent (and evident) adequacy of mathematical entities (which have, according to them, just a mental nature) to "real" world, as the famous "miracle argument" expresses well. This problem gained recently a new approach. Gerhard Heinzmann and Hannes Lietgeb are leading since 2013 an effort to treat these problems from a new perspective, named the representational attitude: instead assuming one of the classical conceptions, they try to focus their arguments in three main questions: first, what is the relevance of mathematical practice in order to determine mathematical objects; second, in what sense informal rigor can be determined by these stipulations; and third, in what sense it is possible to characterize informal provability by formal means, that is, propitiating the use of logic and mathematics as a tool for epistemology. Thus, I intend to argue that Brouwer's intuitionism, no matter being a formulation committed with an anti-realist position, already flirts with this kind of approach. The main arguments that will be detailed in the paper are roughly the following: Brouwer's intuitionism (i) argues that the conception of mathematical objects and their rules are established in function of their role in mathematical constructions; (ii) logic is conceived as a particular case of mathematical ordination; and (iii) formal provability looks like being always contentual. Therefore, I intend to show more sharply the proximities and distances which exist between representational approach and Brouwer's intuitionism.

Why Post did not have Turing's Thesis

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Szabo Mate
Philosophy, Carnegie Mellon University, Pittsburgh, USA
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Post and Turing proposed in their independent 1936 papers two strikingly similar models of computation. Indeed, Turing took their similarity as the reason for asserting in his (1950) that the notion of "logical computing machines" had been introduced in 1936 by Post and himself. Davis and Sieg, in their (2014), bring out the deeper conceptual confluence of Post's and Turing's analysis of combinatory processes, respectively mechanical procedures that underlies those models. Despite this confluence, it was only Turing who argued convincingly for the adequacy of his notion to capture the informal concept of mechanical procedure carried out by a human computer, i.e., "Turing's Thesis". Post, by contrast, saw his notion as being involved in an hypothesis that required further confirmation and that might lead to a "natural law" concerning psychological processes. For this reason, Post insisted on a complete analysis of "mental processes involved in combinatorial-mathematical processes". It is this fundamental problem for mental processes Post could not resolve, whereas Turing eliminated the "states of mind" of the human computer, he initially appealed to, by "physical counterparts". In this way Turing could view mechanical procedures as operating on external symbolic configurations and as being restricted only by the sensory limitations of the human computing agent.

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CONTRIBUTED PAPERS / C1.6 PHILOSOPHY OF THE FORMAL SCIENCES

Squeezing feasibility

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This paper inquires into the possibility of adapting Kreisel's *squeezing argument* [4] to analyze the informal concept of *feasibly computable function* studied in computational complexity theory. Kreisel originally proposed the squeezing argument to show that the class $\mathcal{I}_v$ of statements which are informally valid-in-virtue-of-form aligns in extension with the class $\mathcal{F}_v$ of formal validities of first-order logic. In [5] and [6] he also hinted that a similar argument could be given in support of Church's Thesis – i.e. the extensional alignment of the class $\mathcal{I}_c$ of informally computable functions with the class $\mathcal{F}_c$ of partial recursive functions.

Smith [8] has recently reconstructed such an argument as follows:

1) If $f : \mathbb{N}^k \to \mathbb{N}$ is computable by a member of an "austere" model of computation $\mathfrak{M}_1$, then $f(\vec{x}) \in \mathcal{I}_c$.
2) If $f(\vec{x}) \in \mathcal{I}_c$, then $f(\vec{x})$ is computable by a member of a "rich" model $\mathfrak{M}_2$.
3) For appropriate choices of $\mathfrak{M}_1$ and $\mathfrak{M}_2$, we may formally prove that the two models determine the same class of functions. Since by 1) and 2) we have "squeezed" the intuitively computable function between those computable by $\mathfrak{M}_1$ and $\mathfrak{M}_2$, we may therefore conclude $\mathcal{I}_c = \mathcal{F}_c$.

When "austerity" and "richness" are understood in terms of the basic operations and modes of computation circumscribed by $\mathfrak{M}_1$ and $\mathfrak{M}_2$, many choices for these models are available in virtue of classical equivalence results.[1] The questions which will be addressed here are as follows:

I) What would plausible choices for $\mathfrak{M}_1$ and $\mathfrak{M}_2$ be were we to attempt to adapt this argument in order to demonstrate the alignment of the informally characterized class $\mathcal{I}_f$ of feasibly computable functions – i.e. those computable "in practice" – with the class $\mathcal{F}_f$ of those computable by a proposed formal model of feasible computability?

II) For given choices of models, can non-circular arguments analogous to steps 1) and 2) be provided? For instance is it possible to provide an "informally rigorous" argument that all functions computable relative to formal models of feasibility proposed by Cobham [1], Cook [2], or Leivant [7] are genuinely computable in practice?

[1] A. Cobham. The intrinsic computational difficulty of functions. In Proceedings of the Third International Congress for Logic, Methodology and Philosophy of Science, Amsterdam, pages 24–30. North-Holland Pub. Co., 1965. [2] S. Cook. Feasibly constructive proofs and the propositional calculus (preliminary version). In Proceedings of seventh annual ACM symposium on Theory of computing, pages 83–97. ACM, 1975. [3] A. Kolmogorov and V. Uspensky. To the definition of algorithms. Uspekhi Mat. Nauk, 13(4):3–28, 1958. [4] G. Kreisel. Informal Rigour and Completeness Proofs. In Problems in the Philosophy of Mathematics, pages 138–186. North-Holland, Amsterdam, 1967. [5] G. Kreisel. Some reasons for generalizing recursion theory. In R. Gandy and C. Yates, editors, Logic Colloquium 69. North-Holland, Amsterdam,

1971. [6] G. Kreisel. Which number theoretic problems can be solved in recursive progressions on ∏1-paths through O? The Journal of Symbolic Logic, 37(2):311–334, 1972. [7] D. Leivant. A foundational delineation of Poly-Time. Information and Computation, 110(2):391– 420, 1994. [8] P. Smith. An introduction to G\"odel's Theorems. Cambridge University Press, 2013.

Justifying proof-theoretic reflection

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It can be argued that by accepting the axioms of a theory as formally expressing our intuitive grasp of a mathematical structure—e.g. PA for arithmetic—we thereby implicitly commit ourselves to accepting certain other statements that are not formally provable from the axioms because of the incompleteness phenomena— such as the statement expressing the soundness of the axioms—and therefore to a fundamentally stronger theory. It follows that any formal theory that aims at capturing our pre-theoretic understanding of the natural numbers structure must admit of extensions; the question then arises as to how the axioms of arithmetic should be extended in order to construct a formal system that allows us to talk rigorously about the scope and limits of our arithmetical knowledge.

The process of recognising the soundness of the axioms is conceived of as a process of reflection on the given theory and the kinds of methods of proof that we recognise as correct. For this reason, the addition of proof- theoretic reflection principles as new axioms can be thought of as representing a natural way of extending PA in order to capture arithmetical knowledge.

I will distinguish two main strategies to justify the addition of reflection principles to be found in the literature (via transfinite induction, and via our truth-theoretic commitments), and I will argue that, contrary to these approaches, proof-theoretic reflection should be justified on the same fundamental grounds as our acceptance of the axioms of the initial system (see e.g. Feferman [1962]). More specifically, I will argue that local reflection can be justified on these grounds, and I will consider whether this argument can be extended to the justification of uniform reflection.

C1.7 PHILOSOPHY OF THE FORMAL SCIENCES

Thursday, August 6 • 17:00–19:00
Main Building, Room 6

Reference and Invariance in Abstraction Principles

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An abstraction principle has the form §F ? §G ↔ Eq(F, G), where § is an abstraction operator mapping Fregean concepts into objects, and Eq is an equivalence relation holding between concepts. Abstraction principles trace back to Frege. Well-known examples are Hume's Principle and Basic Law V. These principles provide identity conditions for the individuation of abstracta, since they provide a means to identify the entities the identity statement of the left-hand side involves, by appealing to the identity criterion embodied by the equivalence relation on the right-hand side. By individuation, they also provide a way to attach referents to the abstract-terms on the left-hand side. Famously, though, abstraction principles fail to provide sufficient conditions for such an individuation, and thus, it may be argued, they fail to provide a way to fix the reference of the abstract-terms they govern. This is known as the Julius Caesar problem. By the notion of parametric reference in logico-mathematical reasoning, I propose to detach individuation of abstracta from the fixing of reference of abstract-terms, to the effect that, in order to fix the reference of abstract-terms, individuation of abstracta is not needed. I argue for this view and I provide an appropriate semantics for parametric reference. Furthermore, I investigate a possible argument against this view, according to which the philosophical advantages of the (neo-)Fregean interpretation of abstraction principles as unveiling the nature of Fregean abstracta are lost by the approach via parametric reference, and make this latter approach philosophically unsubstantial. As a reply, I claim that, by using parametric reference, philosophical advantages other than those the (neo-)Fregeans envisage may be obtained. In this respect, I investigate the relation between parametric reference and the notion of invariance under permutations, in order to retrieve the logicality of abstraction principles on different grounds than the (neo-)Fregeans'.

Characterization of the style of mathematical proving by means of Roman Jakobson's communication model

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Greek Open University, Athina, GREECE

By mathematical proving (or proof-event) is understood a spatio-temporal social processes that necessarily involves two agents: a prover and an interpreter [Goguen 2001]. Proof events generate proofs presented by means of a variety of semiotic codes in different styles, which characterize different cultures, national schools or individual scholars that may differ in views of meta-theoretical character on what a proof is. In this framework, style is defined as a meta-code that determines the individual mode of integration (selection, combination, blending) of concepts into a narrative structure (proof) and depends on the selected code and the underlying semiotic space [Stefaneas, Vandoulakis 2014].

Styles perform certain communicative functions that concern not only the elegance of exposition of a proof (the way of writing a proof, the manière of the individual prover). They might facilitate or obstruct understanding of a mathematical proof by an interpreter, depending on the metaphors used in the narrative (semiotic) space and the communicational features of the codes and metaphors chosen.

In this paper, we attempt to describe the communicative functions of mathematical proving styles by appealing to Roman Jakobson's communication model. This model was initially conceived for describing the communicative functions of language. However, it can be modified and specified for use in any medium of communication, in particular in the medium of mathematical proving, computer-generated proving, Web-based proving, and others. Within this model, eventual aesthetic pleasure gained from mathematical proving can be associated with the poetic function. It is an ideal for a pure mathematician (prover) to find an elegant proof and cause the interpreter aesthetic pleasure from his proving activity and its "stylized" outcome.

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Ampliative Reasoning: The Specificity of Mathematical Language and the Uses of Ambiguity

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In serious mathematical research, problem-solving typically enlarges knowledge, going beyond what is currently accepted, and given in the formulation of the problem. This fact about research has been obscured by the assumptions of twentieth century philosophers of mathematics, who supposed that mathematical reasoning can be translated into predicate logic, and then located within the closed box of an axiomatic system, proved from the first principles by deductive logic. However, as Danielle Macbeth reminds us, mathematical reasoning is carried out in highly specific languages, both symbolic and iconic, which are created for solving certain kinds of problems about certain kinds of things, and within those limits are especially powerful. Thus, one-way translation (into predicate logic, for example) diminishes the expressive, explanatory and exploratory power of those languages. Moreover, as I have often argued, translation may nonetheless enhance the expressive, explanatory and expressive power of mathematical languages, but only when the disparate languages are retained: juxtaposed, superposed, or brought into novel rational relation by natural language. It is thus philosophically rewarding to examine in some detail how the growth of mathematical knowledge occurs. I will use two specific episodes from the history of number theory (one from algebraic number theory, and one from analytic number theory) to show how problem-solving adds significant content to mathematical knowledge. We will examine the use of the algebraic number field Q[v-1], and more generally nth roots of unity and their associated cyclotomic fields; and then we will examine the use of the complex plane as the setting for studying elliptic curves, and more generally modular curves and modular forms, and automorphic forms.

Polyadic and Higher-Order Abstraction Principles

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Since the work of Wright (1983), philosophers of mathematics have devoted considerable attention to "conceptual" abstraction principles--principles formulated using an operator that takes singulary second-order terms to first-order terms. Higher-type and polyadic analogues of such principles, however, have received almost no study; almost all known results are found in two papers by Roy Cook (2003, 2009). In this paper, I expand on Cook's work. In the polyadic case, I introduce n-ary Restricted Isomorphism Abstraction Principles (RITAs), generalized versions of Cook's (2003) Size-Restricted Ordinal Abstraction principle (SOAP). SOAP has models of every infinite cardinality; in contrast, whether an n-ary RITA for n≥2 has a model of size κ may depend on facts about κ independent of ZFC. In this respect, the RITAs closely resemble Boolos's (1989) principle New V, whose model-theoretic behaviour was studied by Shapiro and Weir (1999). Unlike New V, however, the n-ary RITAs will have models of singular cardinal size if GCH holds. The higher-type case is more complicated. Cook (2003) showed that the satisfiability of nth-order analogues of Hume's Principle, n>2, is independent of ZFC; if GCH holds, however, then the collection of finite-order analogues of HP has a model of every infinite cardinality. In contrast, I show that nth-order analogues of New V, SOAP, and the RITAs are unsatisfiable for any n>2 even if GCH holds. I also show that even Cook's result about higher-order analogues of HP depends on the assumption that the background type theory is extensional, and I discuss the relevance of this result for hyperintensional type theories of the kind discussed by Muskens (2007). Finally, I summarize the philosophical importance of these considerations, focussing on the question whether polyadic and higher- type generalizability is a requirement for an abstraction principle's acceptability.

C1.8 PHILOSOPHY OF THE FORMAL SCIENCES

Friday, August 7 • 11:00–13:00
Main Building, Room 6

Dispensability of Higher-Order in Mathematics

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A generalization of the translation of existential second-order sentences to independence-friendly logical sentences shows that further complications in the hierarchy of second-order sentences is actually a combinatorial deepening of first-order sentences with arbitrary independences between quantifiers and connectives. Hence by way of such generalization the entire second-order logic can be reconstructed in the fully extended independence-friendly logic. The reconstruction in question proves that higher-order notions are, on the most elementary level, dispensable in mathematical reasoning. Therefore, at least in principle, mathematical reasoning can be logically analyzed solely on the level of particular constructions. It will be argued that the particular constructions in question can be freely introduced into the reasoning, and hence there is no limitation that is dictated by the order of logical rules on mathematical activity.

Constructive Axiomatic Method in Euclid, Hilbert and Voevodsky

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The version of axiomatic method stemming from Hilbert [Hilbert (1899)] and recently defended by Hintikka [Hintikka (2011)] is not fully adequate to the recent successful practice of axiomatizing mathematical theories. In particular, the axiomatic architecture of Homotopy Type theory (HoTT) [Voevodsky et. al. 2013] does not quite fit the standard Hilbertian pattern of formal axiomatic theory. At the same time HoTT and some other recent theories fall under a more general and in some respects more traditional notion of axiomatic theory, which I call after Hilbert and Bernays [Hilbert&Bernays (1934-1939)] "genetic" or "constructive" (interchangeably) and demonstrate it using the classical example of the First Book of Euclid's "Elements". On the basis of these modern and ancient examples I claim that Hintikka's semantic-oriented formal axiomatic method is not self-sustained but requires a support of some more basic constructive method. I provide an independent epistemological grounding for this claim by showing the need to complement Hintikka's account of axiomatic method with a constructive notion of formal semantics.

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Geometric reasoning and geometric content

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According to the modern view of geometry, geometrical content is determined by a consistent set of axioms (which define structures implicitly, but do not express propositions) and further articulated through logical deductions. However, neither Bolyai nor Lobachevski, whose investigations of hyperbolic geometry initiated the move towards the modern view, regarded geometry in this fashion. Nor were considerations of consistency the driving force of Beltrami and Klein's famous 'models' of non-Euclidean geometry. Thus, it seems that the modern view of geometry cannot account for the developments in 19th century geometry that led to it. In this paper, some of the background of the emergence of the modern view of geometry is presented. In particular, I will focus on three distinct developments: the work on 'abstract' geometry and its relations to Euclidean geometry (Bolyai, Lobachevski, Beltrami, Klein), the realization of duality in projective geometry (Poncelet, Gergonne), and the work on axiomatizations of geometry (Pasch, Hilbert). These developments reveal that two different modes of reasoning were at play in the geometric investigations in the 19th century: An objectival mode, where language is merely a means to reason about geometric objects, and an linguistic mode, which focuses on the language itself. I will argue that these two modes of reasoning gradually led to a separation of the syntactic (linguistic) and semantic aspects of geometrical reasoning, which can be found in the views expressed by Poincaré and Hilbert at the turn of the 20th century. Finally, I propose two different notions of geometric content that are tied to the two modes of reasoning just mentioned, in order to interpret the various practices of geometry in the 19th century.

Gödel's Second Incompleteness Theorem Is Predicate Dependent

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Abstract. It is shown that Gödel's proof of the second incompleteness theorem for formal arithmetic depends on the chosen provability predicate. We come up with an unprovability predicate which is used to construct counterexamples to the second theorem and prove that in the general case the conclusion of the second theorem is not true.

Mathematics Subject Classification (2010). Primary 03A05; Secondary 00A30.

Keywords. Gödel's incompleteness theorems, inadequacy of provability predicate, unprovability predicate.

According to Gödel's second incompleteness theorem, if the formal Peano arithmetic (PA) is consistent then *Consis*, i.e., the formula

$$\exists x \forall y \neg \mathrm{Prov}(x, y), \qquad (*)$$

is unprovable in PA. But the proof of the second theorem is clearly not sufficient to conclude that no other (nonequivalent to Gödel's *Consis*) formula 'expressing' the consistency of PA is provable in PA. The question whether it is possible to construct a decidable formula 'expressing' the consistency of formal systems containing PA was taken up by S. Feferman, S. Kleene et al. However, the authors construct their formulas 'expressing' the consistency of PA as derivatives of the Gödel formula *Consis* and the provability predicate. But the provability predicate is not the best candidate to 'express' the consistency of PA.

The following is a simple consequence of the second theorem showing inadequacy of Gödel's representation of unprovability:

Corollary (we call it Theorem 2+). (1) *If* PA *is consistent, then, for any formula A, a formula that 'expresses' the unprovability of A is unprovable in* PA.

(2) *If* PA *is ω-consistent, then, for any formula A unprovable in* PA, *a formula that 'expresses' the unprovability of A is undecidable in* PA.

According to this theorem, there exist infinitely many closed formulas that are undecidable in PA, and moreover, formulas that 'express' commonplace meta-arithmetic judgments, too, turn out to be undecidable. For example, Theorem 2+ implies that the formula

$$\forall y \neg \mathrm{Prov}(\ulcorner \neg(\mathbf{0}=\mathbf{0})\urcorner, y),$$

which 'expresses' the unprovability of a formula $\neg(\mathbf{0}=\mathbf{0})$, is undecidable and, hence, is unprovable in PA. In fact, however, a proof (by contradiction) that $\neg(\mathbf{0}=\mathbf{0})$ is unprovable is quite elementary, provided PA is consistent.

It is very important to realize that the choice of a predicate $\mathrm{Pr}(x,y)$ and its corresponding formula $\mathrm{Prov}(x,y)$ (or their derivatives) as exceptional tools for representing (un)provability in PA—despite its apparent naturality—is in *no way grounded* by Gödel and his followers. These tools are chosen absolutely arbitrarily. Moreover, the question if it is possible to use radically different expressive means has not even been posed yet. Below we do look into just this question.

If PA is consistent, and $\neg A$ is a formula provable in PA, then A is obviously unprovable by the definition of consistency. Consider the *unprovability* predicate $\mathrm{NPr}(x,y)$ which is satisfied iff x is the Gödel number of some formula and y is the Gödel number of a proof of its negation. Clearly, this predicate is decidable. Consequently, the predicate $\mathrm{NPr}(x,y)$ is 'expressible' in PA via some formula $\mathrm{NProv}(x,y)$, while the fact of there being an unprovable formula in PA is 'expressed' by the formula

$$\exists x \exists y \mathrm{NProv}(x,y). \qquad (**)$$

A formula $(\mathbf{0}=\mathbf{0})$ is derivable in PA, and so therefore is $\neg\neg(\mathbf{0}=\mathbf{0})$ since $\vdash ((\mathbf{0}=\mathbf{0}) \sim \neg\neg(\mathbf{0}=\mathbf{0}))$ in PA. Let $\boldsymbol{n}$ be the Gödel number of a derivation of the formula $\neg\neg(\mathbf{0}=\mathbf{0})$. The definition of a predicate $\mathrm{NPr}(x,y)$ implies that $\mathrm{NPr}(\ulcorner\neg(0=0)\urcorner, n)$ is true. In view of the 'expressibility' conditions, therefore, $\mathrm{NProv}(\ulcorner\neg(\mathbf{0}=\mathbf{0})\urcorner, \boldsymbol{n})$ is provable in PA. If existential generalization is applied twice to the last formula, then we arrive at a derivation of $(**)$. Thus a formula 'expressing' the existence of an unprovable formula is provable in PA. Consequently, arithmetic can well "prove its own consistency."

Thus, the statement of the second theorem turns out to be predicate dependent: a formula that is based on $\mathrm{Prov}(x,y)$ and 'expresses' the consistency of PA is unprovable, while a formula based on $\mathrm{NProv}(x,y)$ is elementarily provable. This directly disproves the generally accepted universal interpretation of the second incompleteness theorem: "In *any* theory containing arithmetic, *any* formula expressing its consistency is unprovable if the theory itself is consistent."

C1.9 PHILOSOPHY OF THE FORMAL SCIENCES

Friday, August 7 • 14:30–16:30
Main Building, Room 10

Philosophy of logical practice: a case study in formal semantics

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This paper seeks to advance a nascent domain of inquiry known as "philosophy of logical practice" and to provide a concrete example of original research in this domain by way of a case study in formal semantics. Over the past few decades, logic has spawned a lively scientific community with its own social norms, rules of behavior and procedures for generating new results; consequently, I believe that an adequate philosophy of logic needs to account for logical practice and provide an explanation for the practices and procedures of the logical community. Philosophy of logical practice seeks to do so by combining historical, philosophical and social scientific studies of logic. In this paper I demonstrate one possible approach to philosophy of logical practice by way of a case study in formal semantics, which is a particular form of logical practice. In 2011, Martin Stokhof and Michiel van Lambalgen (two prominent formal semanticists) provocatively raised the question: "is formal semantics a failed discipline?" The question sparked an intense debate among leading researchers in the field in a special issue of the journal "Theoretical Linguistics." My case study discusses this question by drawing primarily on the methodological framework of qualitative research in the social sciences — in particular, this case study is structured as an interview study featuring interviews with critics, insiders and outsiders of formal semantics. Major themes that emerge from the case study are: (1) the tension between the scientific and philosophical aspirations of formal semantics as a discipline, (2) the tension between the narratives and the everyday practice of formal semantics, and (3) the trend towards empirical, data-driven research in the larger field of linguistics. Hopefully such research will encourage more formal semanticists, logicians, philosophers and mathematicians to reflect critically upon the goals, methods and narratives of their respective disciplines.

Philosophy of Operator Algebra: Understanding of Infinite through Algebraic Structure and Dynamics

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This presentation attempts to apply to modern mathematics "Philosophy of Concepts" developed by, among others, J. Vuillemin. Utilizing the method of Vuillemin's "La Philosophie de l'algebre" (1962), which philosophically analyzes the birth of Galois group and its extension to many domains of mathematics, I hope to clarify how some concepts in von Neumann algebra, one of operator algebras, were born and generated.

Since usual Analysis cannot appropriately treat the points of zero measure, such pathological phenomena as Cantor set and Banach-Tarski theorem appear. They issue from the measure of "infinitesimal". Instead of considering space as a set of points of measure zero, operator algebras take their algebraic structure as points of departure. The analytical definition of von Neumann algebra as closed by strong topology is equivalent to its algebraic definition as equal to its double commutant algebra. For this reason, the projection operators of von Neumann algebra have a structure of complete orthomodular lattice. Based on this fact, von Neumann algebra is classified according to the density of its projection operators. Moreover, M. Tomita, M. Takesaki and other mathematicians introduce modular automorphism groups, i.e. time development as dynamics, into von Neumann algebra and understand them as crossed products with topological groups. As ergodic theory and KMS condition issued from equilibrium system of quantum statistical dynamics are also integrated, von Neumann algebra develops as dynamical system. Analogically to the fact that commutative von Neumann algebra is isomorph to usual Lebesgue measurable space, noncommutative measurable space is constructed as dual to von Neumann algebra, which is noncommutative in general.

This presentation clarifies how Leibniz' differential and integral, which depend on infinitesimal calculus, as well as Newton's method of fluxions, which depend on dynamics, come down to modern operator algebras, which circumvent pathological phenomena that issue from "infinitesimal" through algebraic structure and dynamics.

Set existence principles in reverse mathematics

Eastaugh Benedict
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What axioms are necessary to prove theorems of ordinary mathematics? The research programme formed to answer this question, reverse mathematics, has enjoyed great success since its inception in the 1970s. Connections were drawn early on between the Big Five systems to which most theorems of ordinary (countable) mathematics were proved to be equivalent, and foundational programmes motivated by philosophical concerns such as Hilbert's programme and Weyl's predicativism. But do reversals have a significance that goes beyond their usefulness in analysing the mathematical strength of proposed foundations? And if so, in what does this significance lie? The standard view in the field is that reversals track the set existence principles necessary to prove theorems of ordinary mathematics. The Big Five systems of reverse mathematics are all held to express set existence principles. While this view has intuitive appeal, the central concept of a set existence principle is unclear. One obvious way of spelling it out would be to identify set existence principles with comprehension principles, or more broadly, with separation principles. However, there are mathematically natural systems such as weak-weak König's lemma which cannot be thus characterised. To save the standard view we thus need a new account of what set existence principles are. I propose understanding them as closure conditions on the powerset of the natural numbers. Such an account readily incorporates examples such as WWKL0, but it also seems to suffer from an obvious problem, namely that it makes all Pi^1_2 statements express set existence principles. So we need to find a way to restrict the account. One such restriction would be to invoke the notion of a natural theory: on this modified view, reversals track natural closure conditions on the powerset of the natural numbers.

Circularity and meaning: a version of logical pluralism

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Lògica, història i filosofia de la ciència, Universitat de Barcelona – LOGOS, Barcelona, SPAIN

I want to argue in favor of a kind of logical pluralism: I claim that both classical and relevant logic are correct logics, as natural language is ambiguous between classical and relevant interpretation of the connectives.

To illustrate my claim I focus on the discussion between Greg Restall and Stephen Read about the validity of Disjunctive Syllogism. The rejection of Ex Falso Quodlibet by relevantists implies the rejection of Disjunctive Syllogism, which seems to be a valid argument. Relevant logicians, as Read (monist relevant logician) and Restall (pluralist relevant logician) have to explain this couterintuitive result. Both Read and Restall accept the invalidity of DS in relevant logic, however, their justication diers as a result of their background theories: Read argues that there is an intensional version of the DS which is valid, in which the disjunction that is used is the intesional disjunction `+', while Restall denies its relevant validity, while accepts it in classical logic.

My argument for pluralism has two parts: first, I identify the circularity in which they fail when they argue in favor and against the validity of this principle: in order the accept/reject the validity of DS one has to accept/reject it on the metalanguage that uses for arguing about logic. Classical extensional connectives support the validity of DS, while relevant intensional connectives reject it. Second, once the circularity is identified, I want to claim that both intensional and extensional connectives are legitimate formalizations of natural language connectives. That is, there is more than one logic as there is more than one legitimate formalization of natural language, and the validity of some inferences, as DS, is relative to the logic and language one chooses.

C1.10 PHILOSOPHY OF THE FORMAL SCIENCES

Friday, August 7 • 17:00–19:00
Main Building, Room 10

Jerzy Neyman on Sampling and Experimentation - Parallels to Bayesian Rationale.

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Lipski Piotr
The John Paul II Catholic University of Lublin

Jerzy Neyman (1894-1981) was a Polish statistician renowned for his essential insight to frequentist paradigm of statistical inference. Philosophers are mostly interested in his ideas concerning parameter estimation and hypothesis testing. Yet, he also made salient contribution to developing methodology for experimentation and sampling. His most important inputs to this field are: proposing an explicit model for randomized and non-randomized experiment, using repeated-sampling evaluations over randomization distributions, providing explicit formal definition of causal effect in randomized experiment, inventing the method of cluster sampling, and formulating conditions for validity of purposive sampling for probability sampling.

It is admitted that Neyman's frequentist methodology and philosophy of science are in arrears with Bayesian paradigm. However, certain arguments for reconciliation of both paradigms were recently presented in philosophy. Nevertheless, these were related to parameter estimation and hypothesis testing. The aim of this paper is to analyze Neyman's ideas on experimentation and sampling design with the angle of establishing parallels to elementary Bayesian rationale of scientific methodology.

I will proceed with the following steps. Firstly, I will argue that frequentist outcome is not sensitive to private intentions on when to stop the sample, but to prior objective knowledge about an investigated population. Secondly, I will analyze, using Neyman's examples, whether determining the stopping rule is analogous to rendering informative prior within Bayesian inference. Based on an example from ecology and Neyman's methods for stratified sampling I will illustrate the convergence of the frequentist and Bayesian outcomes by showing symmetry between Bayesian use of conditional probability and frequentist use of representative method. Finally, I will reflect on Neyman's conceptual tools for embodying arbitrary elements and additional information into sampling scheme and on his criteria for probabilistic reliability of purposive sampling. I will ask if they are parallel or close to fundamental features of Bayesian rationale.

Varieties of Frequentism

Benedictus Fedde
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In my presentation I wish to compare the little-known, early frequentist interpretation of probability that was defended by Hans Reichenbach in his 1916-dissertation with the much better known frequentism of Richard von Mises (1918/1928). I will begin by showing how both Reichenbach's and von Mises' interpretations differ from earlier `objective`' interpretations – most notably that of Johannes von Kries (1886). By identifying the differences between the 20th century frequentists and the earlier objectivists , I will be able to lay bare the (sometimes tacit) assumptions that the later authors need to make in order for their respective interpretations to be coherent. My analysis will show that within 20th century frequentism there are significant individual differences.

Von Kries attempted to give Laplace's classical definition of probability an objective basis. In von Kries' interpretation any probabilistic statement is based on physical symmetries. Reichenbach and von Mises forgo any explicit reference to physical structures, and define degrees of probability as relative frequencies within a sequence of outcomes of repeatable events. Both Reichenbach and von Mises believe that the most important demand for any theory of probability is that it gives us a basis for rational expectation. It is this belief that led them to define degrees of probability as relative frequencies in the first place. The similarity in the way both authors justify this belief is striking (particularly when we realize that Reichenbach's philosophy has its roots in neokantianism). However, despite the fact that Reichenbach and von Mises agree on this role of probability, only Reichenbach attempts to give the rationality-demand a mathematical form (that the probability- distribution must be continuous) that tells us which relative frequencies correspond to which degrees of probability. In a letter to Bertrand Russell Reichenbach emphasises the differences between the probability- interpretation of von Mises and his own.

CONTRIBUTED PAPERS / C1.10 PHILOSOPHY OF THE FORMAL SCIENCES

On the explanation of linkedness of Kolmogorov's requirements to probabilities

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In the well-known work of Kolmogorov, where the axioms of the probability theory were formulated, also proposed the principles A and B that determine the properties of probabilities in the context of applications of the theory. A states that for a large number of trials, the probability of event is close to its frequency. B, which coincides with Cournot's principle, prohibits the realization of a low-probability event in a single trial. It has been long known that A is derivable on the basis of B and Bernoulli's theorem. However, there was no any explanation of the rationality of the dependent principle A before the article "The Sources of Kolmogorov's Grundbegriffe" by Shafer and Vovk. The strongest explanation was connected with frequency character A, since Kolmogorov follows Mises in context of applications. However, it has a somewhat subjective character. We propose epistemological and formal arguments in favor of the validity of this explanation.

Firstly in the theorem, the theoretical probability of success is known, although in the frequency interpretation the theoretical values are unknown. A low-probability event occurs rarely, but can occur in any trial, which is not consistent with B. We mark A is natural on its own and not as a corollary of Bernoulli's theorem in the frequency interpretation. Secondly, we propose a model of the frequency interpretation based on a coin tossing experiment. It is supposed that k series of experiments are carried out, each consisting of n tosses. The probability of success in the Bernoulli's theorem is considered unknown and determined on the basis of k frequency characteristics if mostly of them belong to an interval, whose length is less than a predetermined calculation error. In the case verification of A is not necessary. So the statement A is justified in comparison with B and Bernoulli's theorem.

A Savage-style Decision Theory for Imprecise Probabilities

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Haim Gaifman
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Modern Bayesian decision theory seeks to ground Bayesian reasoning in a logical process of rational decision-making. Central to this goal is the task of specifying how rational agents organize, in a coherent manner, their probabilistic judgments and value considerations in face of uncertainties. The traditional Bayesian subjectivist approach takes the step of reducing a theory of personal probability and utility into a normative theory of rational choice. As exemplified in the work of Savage (1954/1972), the often result of this way of theorizing is a systematic representation theorem, where the decision maker's beliefs and values can be characterized by a single probability measure and a utility function provided that the postulates governing rational decision-making are granted. In this paper we attempt a generalization of Savage's decision model to accommodate logically weaker assumptions. In particular, instead of postulating that the decision maker has a complete preference ranking over all possible actions, it is assumed that the set of available acts is merely partially ordered. This move is motivated by the consideration that the agent may lack rational basis for choosing a preferred act between two given acts due to the indeterminacy involved in her probabilistic assessments. An axiomatic system for rational decision making based on partially ordered preference ranking is proposed. The main result establishes that the agent's preferences can be represented by a utility function and a set of probabilities, i.e., imprecise probabilities. Our generalization is distinctive in that, unlike other competing multi-priors decision models, our system makes no reference to any presupposed chance mechanism, and it has been previously argued by one of the authors that such a system may avoid the dilation phenomena that arise in systems of imprecise probabilities that incorporate both objective and subjective probabilities as basic elements.

C1.11 PHILOSOPHY OF THE FORMAL SCIENCES

Saturday, August 8 • 10:00–12:00
Main Building, Room 10

A behavioral analysis of group knowledge and group behavior

Parikh Rohit
CS, Math, Philosophy, CUNY, New York, NY, USA

Starting with Ramsey, de Finetti and Savage, an analysis of subjective probabilities and utilities was carried out based on an agent's (potential) behavior. If a subject acted according to Savage's axioms then the subject could be seen as maximizing expected utilities. There were some difficulties with this picture, pointed out by Allais, Ellsberg, Kahneman and Tversky, and others. But the picture does often work and is of value. What about the many agent case? How can we know what A knows about B's knowledge? There is some intuition present already, as for example in the work of Wimmer and Perner, or the work of Premack and Woodruff. When we ask if an agent has Theory of Mind we ask whether an agent's behavior shows awareness of another's knowledge. Perhaps, if we are lucky, we can even ask for a test of whether common knowledge exists and can be exhibited behaviorally. We will refer to work by people like Clark and Marshall, Parikh, Pinker, and Verbrugge which addresses such questions and offer a formal theory. We will also offer suggestions on the thorny issue of "Do collectives exist as real agents?"

CONTRIBUTED PAPERS / C1.11 PHILOSOPHY OF THE FORMAL SCIENCES

Mathematical knowledge as social knowledge

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In this essay I am going to demonstrate my belief that between classical and intuitionist Mathematics there are deep but not abyssal differences, which under certain circumstances could be abridged. Most mathematicians consider mathematical knowledge as epistemologically indifferent or neutral and although most of them admit mathematical knowledge as the a priori knowledge par excellence (commencing from Kant to Frege, Brouwer, Hilbert, Goedel), mathematical knowledge as a derivative of physical theories must be grounded on the recognition and acceptance of the fact that Mathematics is a social practice. We can formulate a mathematical knowledge program which will take into account the knowledge that a community shares: books, intellectuals, authorities, institutions as they are reflected in society and affect it.

This indicates that a dense network of interrelations and references is formed (Wilder, 1952, 1953; Kitcher, 1983). The view that I support does not emphasize on certain empirical phenomena, but explores basic mathematical practices. Some of the most important mathematical notions, as "pair", "set", "collection", originate from every day practices and they might or might not have a mathematical importance before they become mathematical objects. Later on, notions as "next" enter social life through Mathematics, in which they were primary used, in order to clarify the meaning of getting from a natural number to the next one. So we see a vast number of social notions produced by and used in Mathematics – and the reverse. Mathematics is an objective subject. This means that we can find a common ground between classical and

intuitionist Mathematics, based on semantic realism. The differences between the two main mathematical streams are legitimate and earn their validation through history. Under this aspect they cannot be - either of them – overthrown. Their common ground is not indicated as independent reality, as semantic realism would have us assert, but as a notional and linguistic substratum which is denoted through rigid designators (Kripke, 1980). The common ground could be enforced, according to Bridges, Richman (1987), interpolating Bishop's constructive Mathematics. Finally, we could splay this narrow body of Mathematics towards both directions: classical or intuitionist.

Analyticity in Formal Systems

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Recently, Timothy Williamson (among others) proposed the following argument template against the claim that a given sentence, s, is analytic:

P1: If s is analytic, then whoever understands s assents to s.
P2: Some people understand s but don't assent to s.
∴ C: s isn't analytic.

I argue that Williamson's version of this argument with s a sentence of a formal system (such as

FOL or set theory) suffers from an ambiguity.

Saying that person A assents to a sentence s of a formal system F is ambiguous between saying that A assents to:

(i) "s (and F) correctly apply to d," for some domain d,

(ii) "F is a consistent or 'appropriate' system,"

(iii) "s is 'part of' F."

First, I claim that "assent" in P2 should be understood as in either (i) or (ii), and not (iii). I argue that Graham Priest—Williamson's examples for P2 with s stating Modus Ponens—doesn't assent to FOL correctly applying to natural language, but assents to s being "part of" FOL. I consider other possible examples in support of P2 (viz. Edward Nelson and Solomon Feferman) where the proper interpretation of "assent" in P2 is as in (ii).

Second, I argue that "assents" in P1 should be understood (roughly) as in (iii). For this, I propose a conception of analyticity for sentences of formal systems which resembles Carnap's and according to which s of F is analytic just in case understanding s requires believing that s is generally thought to be part of F within a certain practice or community. I defend this account by looking at specific examples in set theory and by drawing a parallel with a (plausible) account of understanding words due to Putnam, according to which understanding words in natural language requires knowing certain associated stereotypes or "core facts."

C1.12 PHILOSOPHY OF THE FORMAL SCIENCES

Thursday, August 6 • 14:30–16:30
Main Building, Room 16

Justifying Deductive Inference

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There is a tension between the usefulness of deductive inference on the one hand, and its legitimacy on the other. For a deductive inference to be legitimate, the process of recognizing the premises as true must already have accomplished whatever is needed for the recognition of the truth of the conclusion. For a deductive inference to be useful, a recognition of its truth need not actually have been accorded to the conclusion when it was accorded to the premises (M. Dummett, 'The Justification of Deduction', 1973).

Not all inferences we make are deductive: we often reason from true premises to a conclusion that is not guaranteed true. Examples of such ampliative inference patterns include inductive generalization and inference to the best explanation. The power (and use) of ampliative inference lies in its 'jumping to conclusions'. Conclusions reached by these non-deductive methods are not guaranteed true, but they are not completely random either; they are in most cases very likely.

Many ampliative inference patterns permit a deductive reconstruction. For instance, if we know that 'p entails q' and we are looking for an explanation for q, then we may conjecture that p (ampliative (abductive) inference). If p were true, then we obtain the explanandum q by modus ponens (deductive reconstruction).

I will argue that, once we acknowledge that inference involves more than mere deduction, we can dissolve the tension between the use and legitimacy of deductive inference as follows. The best way to convince someone of an (ampliative) argument's truth is to present its deductive reconstruction, conjecturing that the premises are true. Deductive logic, then, remains perfectly legitimate, and is useful as a method of exposition because of this legitimacy, i.e. because once we accept the premises are true, we must accept the conclusion.

C2

C2.1 PHILOSOPHY OF THE PHYSICAL SCIENCES

Tuesday, August 4 • 11:00–13:00
Main Building, Room 6

A Discrete Solution for the Paradox of Achilles and the Tortoise

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The paradox of Achilles and the tortoise is one of the most discussed paradoxes on motion. The two main solutions that have been suggested are controversial. First, there are not any consensual solutions on the logical and physical possibilities of supertasks (Black 1951, Benacerraf 1962, Thomson 1970, Burke 2000). Second, McLaughlin & Miller's solution (1992) using non-standard analysis is based on a counterintuitive notion of finiteness (Alper & Bridger 1997, McLaughlin 1998). Another way to solve the paradox consists in denying the continuity of space and time. Van Bendegem (1987, 1995) suggests a discrete treatment of space. However, his solution is unusable for scientists. In this paper, I offer another kind of discrete solution. It differs from the previous one since it turns out to be usable to describe and predict physical phenomena. Besides, the solution is rather based on a discrete treatment of time than on a discrete treatment of space.

The paper is organized as follow. First, I present the discrete solution of the paradox. I show that Achilles overtakes the tortoise in a finite number of steps of Zeno's argument if time is represented as discrete. In the remainder of the paper, I raise two possible objections and I answer them. On the one hand, one could object that the discrete solution is ad hoc and cannot be a satisfying framework for physical theories. On contrary, I show that this discrete solution is embedded in a discrete formulation of classical mechanics that enables to describe and predict physical phenomena (Marsden & West 2001). On the other hand, one could argue that the discrete solution could be falsified by an experiment. On contrary, I show that the discrete and the continuous races of Achilles cannot be distinguished by any experiment.

Einsten's Criticism of Quantum Mechanics and Humean Philosophy

Morita Kunihisa
Faculty of Arts and Science, Kyushu University, Fukuoka, JAPAN

It is well known that (1) Humean Philosophy influenced Einstein when he constructed the relativity theory. It is also well known that (2) one of the reasons Einstein criticized quantum mechanics was its abandonment of causality. Nevertheless, (3) Hume's profound contribution to philosophy is a critique of the necessity of causal connection. Propositions (1)–(3) seem to be inconsistent; thus, Einstein's attitude to Hume seems to be incoherent. As far as I know, however, no one has raised the question whether Einstein's attitude to Hume is really incoherent or not. One possible reason no one has explicitly raised this question is that it is too easy to consider seriously. However, I would like to insist that this question is not so easy. The following answers might come to the reader's mind at first sight: (a) Einstein agrees with Hume's philosophy of space and time, but disagrees with his philosophy of causality; or (b) Einstein's assessment of Humean philosophy changes before and after his construction of the relativity theory. It is certain that the problem vanishes if proposition (a) or (b) is true, but I will show that both of them are false. I will clarify that Einstein's attitude to Hume is coherent by showing that (i) although Hume proves that human reasoning cannot deduce the necessity of causal connection, he does not deny using the concept of causality in science—rather, he admits that the concept of causality is essential for science; and (ii) Einstein admits that the concept of causality is mere convention. Additionally, Einstein criticizes quantum mechanics not only because it seems to allow non-causality but also because it seems to allow for the nonexistence of physical quantity and nonlocality. I also would like to argue Einstein's non-acceptance of these characters of quantum mechanics having the same root.

Measurement in Berkeley's philosophy

Yuki Ozaki
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Measurement is considered to be a fundamental topic in the philosophy of space and time and in the philosophy of physics. In this paper, I will show that Berkeley's philosophy contains an original point relevant to physical measurement. I will compare the concept of measurement contained in Berkeley's philosophy to that contained in Mach's philosophy, and will discuss differences between them. Furthermore, in discussing some philosophical problems relevant to physical measurement both from two philosophical points of view, I also show how the philosophical differences between them will affect arguments concerning the application of the philosophical concepts to the fundamental problems of physics.

C2.2 PHILOSOPHY OF THE PHYSICAL SCIENCES

Tuesday, August 4 • 14:30–16:30
Main Building, Room 14

A Defense of Non-causal Explanations in Relativity.

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Some philosophers of science, such as Harvey Brown (2005) and Margaret Morrison (2000) and some physicists, such as Albert Einstein (1970 [1949]), argue that in Physics only dynamical theories are explanatory. Dynamical theories are those theories which refer to natural laws and describe the underlying physical causal mechanisms to explain and describe phenomena. Such theories are contrasted with principle theories, which do not make a commitment to these underlying features, but refer to high-level regularities, assumptions and empirical observations about the behavior of large objects. This paper argues that there is reason to consider principle theories explanatory. In particular, it shows that the special theory of relativity (STR) explains certain phenomena, such as length contraction, by deriving these phenomena from basic general principles and laws. As such the putative explanations provided by STR can be characterized by Kitcher's unificationist account. I then show that STR is the more unifying theory compared to its key competitors: Poincaré's theory of electrodynamics and Brown's preferred dynamical theory. As such STR is explanatory. Lastly, I conclude by considering Morrison's argument against the explanatory value of the principle interpretation. I argue that Morrison misinterprets Kitcher's unificationist account and therefore her argument is unsuccessful.Indeed, her argument supports my overall argument, rather than undermining it.

Hawking and Penrose: The Reality Debate

Grygiel Wojciech
Philosophy, The Pontifical University of John Paul II, Kraków, POLAND

Stephen Hawking and Roger Penrose belong to the group of the most renowned physicists of the 20th and 21st century. Their main achievement are the theorems on the existence of the spacetime singularities of the general theory of relativity. These theorems indicate the incompletedness of this theory and it is commonly maintained that that this incompletedness can be removed as the quantum effects at the Planck level are taken into accunt. These and other reasons motivate the contemporary search for the theory of quantum gravity that is expected to yield the unified physical descrption of both microscopic and macroscopic regimes. It turns out, however, that this search continues despite of the lack of the experimental evidence calling for such a unified theoretical framework. This clearly attests to the strong metaphysical belief of physicists that the nature is governed by the set of fundamental laws expressed in the language of mathematics. The lack of empirical evidence of quantum gravitational phenomena often forces physicists to rely on additional philosophical assumptions that justify the selected paths of unification. In case of Hawking and Penrose the respective philosophical standpoints are that of positivism and platonism as they themselves declare in many of their both purely physical and philosophical publications. The aim of this study is to demonstrate that the differences in Hawking's and Penrose's physical speculation on the structure of quantum mechanics, the nature of the black holes, the inflationary hypothesis and the information loss paradox originate – stricly speaking – from Penrose's platonic argumentation on the preferred role of the complex numbers and functions in the description of nature. The ensuing controversy resembles the contemporary debate between scientific realism and antirealism and the arguments in favor of each case presented by Hawking and Penrose are typical as formulated in the contemporary philosophy of science. The presented project reveals the intricacies of a very interesting period of the history of physics where the reliance on the broader context of the human intellectual legacy is necessary for the further development of this descipline. In short, physics develops in realities which are broader as those demanded by the mathematical consistency of the theoretical formalism.

Interpretation and Ontology in Special Relativity

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What is the fundamental ontology of a special relativistic world? Philosophers have traditionally approached this interpretive question via two routes. First, they have appealed to 'Earman's dictum' that the symmetries of a theory's ontology must match the symmetries of its dynamical laws, and this has led them to claim that the fundamental ontology of special relativity is represented by those quantities that are Lorentz-invariant. Second, they have appealed to special relativity's four-dimensional space-time formulation, and this has led them to interpret the fundamental ontology of the theory as being those quantities represented by geometrical objects in Minkowski space-time. Although these interpretive approaches are traditionally taken to be equivalent—as different ways of isolating the same fundamental ontology—I argue that these two approaches diverge in significant ways. Using the widely popularised equation E=mc^2 as a central example, and in particular Marc Lange's interpretation of that equation, I show how these two interpretive procedures lead to quite different understandings of the fundamental relationship between energy and mass in special relativity. This not only raises a challenge regarding how we're to understand the fundamental ontology of special relativity, but also motivates a rethinking of the most appropriate approach to the interpretation of dynamical theories in general.

Only Point-Coincidences. Erich Kretschman, the Point-Coincidence Argument and the Emergence of Logical Empiricist Interpretation of General Relativity

Giovanelli Marco
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A 1915 paper of strong conventionalist flavor by Erich Kretschmann might be credited as the source of Einstein's "point-coincidence argument". The talk attempts to show that the paper also unwittingly anticipates the main lines of the logical-empiricist interpretation of general relativity as it was first sketched by Schlick starting from 1917.

While Einstein had taken nothing from Kretschmann but the expression "point-coincidences", the Logical Empiricists instinctively dragged along with it the entire apparatus of Kretschmann's early conventionalism. Kretschmann, inspired by Mach's and Poincaré's, resorted to the point-coincidence parlance in order to point out the "scarcity" of mathematical structure to which observation has access. On the contrary, Einstein's private correspondence shows that, by appropriating Kretschmann's wording, he was dealing with an uncomfortable "abundance" of mathematically different solutions to the field equations allowed by Ricci and Levi-Civita's mathematical technique (hole argument).

Kretschmann realized that Einstein had inserted his point-coincidence remark into a different mathematical tradition, when he turned the point-coincidence argument against Einstein in a second and more famous 1918 paper. On the contrary having failed to recognize this, the Logical Empiricists ended up repeating Kretschmann's 1915 conventionalism. The talk will show that the ambiguity of Einstein's public formulation of the point-coincidence argument resides in the claim that "only" point-coincidences, only the intersections of world-lines, have physical reality. Einstein wanted to emphasize that the question of "where" they intersect is not physically relevant. Starting from Schlick, the Logical Empiricists saw in Einstein's turn of phrase the claim that the lengths of world-lines are not physically relevant.

It was Peter Bergmann (former Einstein's assistant) and his school, who, in the mid-1950s, re-discovered a notion of "coincidence" that was more akin to Einstein's, by discussing the problem of `true observables' in general relativity.

C2.3 PHILOSOPHY OF THE PHYSICAL SCIENCES

Tuesday, August 4 • 17:00–19:00
Main Building, Room 16

The conceptual foundations of Symmetry Breaking and the origin of physics

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Symmetry principles play an important role with respect to the laws of nature, but much of the texture of the world is due to mechanisms of symmetry breaking. In this lecture we want to explore the argument structure of the concept of spontaneous symmetry breaking in the physical Model, we highlight the essential rôle of the asymmetry and finally we dicuss the signification of the symmetry breaking principle in the context of the observed reality.

Quotidian, scientific and fictitious objects under a Russell-Schrödingerian approach: the case of light

Murr Caroline Elisa
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Following a Russell-Schrödingerian approach to the construction of reality, based mainly on Schrödinger's "Mind and Matter" (1956), Russell's The Analysis of Matter (1927), and The Analysis of Mind (1921), it is possible to say that human beings 'objectivate' the world, forming invariants to build reality as we know it. The process of invariant formation involves the subject/object duality as a leading empirical principle. In the dual world, subjects tend to pull apart the general sphere of objects in two parts: scientific and everyday objects, each one built up in a different way. Daily objects are, according to Schrödinger, constituted of real plus virtual perceptions (or expectations), while scientific objects are made of virtual perceptions only. Hence, the objects of science have no direct link to sensations, being described by Schrödinger as 'pure form', composed of pure 'expectations'. On the other hand, some objects are known to take part in both domains. This paper aims to analyze the case of light, advancing that its scientific status changed drastically in the quantum revolution. It has become, since then, much more distant from everyday life's light. Quantum experiments suggest that light can be described neither as a particle nor as a wave; such descriptions alone are not sufficient to explain some experimental results. In addition, we can also place light in another sphere of objects – that of science fiction. For instance, the scientist in H.G. Wells's "The Invisible Man" has to deal with properties of light in order to create the invisibility formula. Finally, science fiction objects, such as light, are based on scientific objects, which in turn depend on everyday objects to be constituted. Therefore, from a Russell-Schrödingerian standpoint, only first order objects are directly linked to sensations, while the third order fictitious objects are built by expectations of expectations.

Prediction in General Relativity

McCoy Casey
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Various prominent physicists and philosophers (among them Earman, Geroch, and Manchak) have claimed that prediction is essentially impossible in the general theory of relativity, the case being particularly strong, it is maintained, when one fully considers the epistemic predicament of the observer. I argue that the conditions on prediction advocated by these authors rest on philosophically misguided and unphysical intuitions. For example, it is argued that an observer has epistemic access to all events in her causal past, but no physical mechanism can account for such powers (due to, for example, the ubiquity of scattering and other physical considerations). Also the result rests on an austere epistemology that requires the observer to know with certainty that she can make a prediction based solely on information which she can gather from her causal past, yet fallibility of knowledge is by now widely accepted as the mainstream position in contemporary epistemology. I show how the concerns I raise thoroughly undermine these authors' results. I therefore claim that they should be rejected as inadequately explicating the concept of prediction in general relativity. Along the way I clarify the epistemic situation of observers and discuss the significance of these arguments for cosmology as well.

On two arguments for the non-renormalizability of gravity

Doboszewski Juliusz
Epistemology, Jagiellonian University, Krakow, POLAND

We will discuss two arguments for the non-renormalizability of gravity. First, there is the perturbative argument: in the effective field theory action for general relativity almost all couplings diverge, hence renormalization fails. The asymptotic safety scenario is a way of disabling the perturbative argument by showing that the couplings do not blow up, but rather approach a non-trivial UV fixed point. As a consequence, general relativity can be presented as a renormalizable quantum field theory.

There is also a different argument for the non-renormalizability of gravity. It is supposed to show that the asymptotic safety is not a satisfactory option by using the supersymmetric methods, as there is no conformal field theory whose density of states coincides with the density of states given by the Bekenstein-Hawking entropy formula in black hole thermodynamics.

From a philoshopical point of view there are several noteworthy issues to be considered here. First, the supersymmetric argument faces difficulties in spacetimes with positive cosmological constant, which significantly limits its applicability. Second, we can circumvent the supersymmetric argument, e.g. via dimensional reduction. In particular, numerical simulations hint that dimensional reduction is a feature of causal dynamical triangulations interpreted as implementing the asymptotic safety scenario.

Finally, we will argue that even if the supersymmetric argument worked, non-renormalizability in general relativity is due to gravitational processes. This is yet another reason for abandoning the traditional understanding of renormalizability as a consistency check for a theory.

C2.4 PHILOSOPHY OF THE PHYSICAL SCIENCES

Wednesday, August 5 • 11:00–13:00
Main Building, Room 6

Typicality in Statistical Mechanics: An Epistemological Approach

Badino Massimiliano
Philosophy, Universitat Autònoma de Barcelona / MIT, Bellaterra (Barcelona), SPAIN

In recent years, the concept of typicality has been the center of a lively debate on the foundations of statistical mechanics. Briefly said, the idea behind this notion is that the size of the set of microstates leading to equilibrium is so overwhelmingly larger than any other set, that the system will "typically" reach the equilibrium during a very short time. According to its upholders, the concept elucidates the emergence of thermal equilibrium by, at the same time, eschewing dubious dynamical assumptions such as ergodicity. Its critics, however, counter that this approach to equilibrium statistical mechanics is not immune from the problems that have traditionally beset ergodic theory or the information-theoretical approach. In spite of the cogency of the philosophical arguments, physicists supporting typicality are far from impressed. Even philosophically-minded physicists do not engage these objections and sometimes even debunk them as misunderstandings. They usually claim that typicality is not a form of probability and therefore much of the probability-based philosophical objections are mere misconceptions. As a result, a potentially fruitful debate on the explanatory value of typicality has now stalled.

In this paper, I argue that part of the problem lies in the fact that philosophers use accounts of explanation too distant from actual scientific practice. My proposal is to consider explanations as epistemic stories that combine a cognitive and a socio-historical dimension. From this perspective, it becomes understandable why many physicists find themselves at ease with the typicality language.

On the probabilistic approach to renormalization

Butterfield Jeremy
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This paper is about the probabilistic approach to renormalization in statistical mechanics, pioneered by authors such as Sinai and Jona Lasinio.

Recall that the central limit theorem (CLT) states that successive standardised averages of independent and identically distributed random variables with a finite variance have the Gaussian N(0,1) as limit. One naturally asks: What about: other ways of taking the average? Or averages of subsequences? Or dependent random variables? Or random variables with infinite variance? Much is known about such questions; and the probabilistic approach to renormalization connects such results to understanding the critical point at the thermodynamic limit.

The key idea of this connection is clearest for the paradigm case of the classical Ising lattice, which associates a random variable with each site of a lattice (or chain). Thus Gibbsian statistical mechanics assigns to each block of the lattice, a probability distribution over configurations (random fields). Critical phenomena involve the large-scale behaviour of such a system. So to understand them, one wants to study the induced probability distributions for successive averages over appropriately chosen larger and larger blocks, i.e. the results of successive block-spin transformations. But due to the interaction between neighbouring sites, the random variables are dependent; and so one seeks appropriate generalizations of the CLT.

The probabilistic results, above, gives such generalizations: some in which the limiting distribution is again

Gaussian, and some in which it is not---allowing one to classify critical points. Physics apart: the main philosophical pay-off is that this approach's results: (i) teach us to think of universality and emergence in terms of domains of attraction of a limiting probability distribution, and (ii) strengthen Khinchin's program in the foundations of statistical mechanics (by weakening his main premise to allow for dependence of random variables, and so generalizations of the CLT).

On How to Approach the Approach to Equilibrium

Luczak Joshua
Philosophy, University of Western Ontario, London, CANADA

A great deal of philosophical literature on statistical mechanics is concerned with recovering aspects of thermodynamics. These works typically aim at recovering something like the following qualitative fact: (T1) isolated macroscopic systems that begin away from equilibrium approach equilibrium and then remain in equilibrium for incredibly long periods of time. The most popular attempts to account for (T1) appeal to typicality. This paper ignores the usual concerns with these accounts and instead highlights their limitations.

These accounts do not underpin the kinds of facts we usually care about most. They also do not have the resources to answer the questions we are most interested in concerning the behaviour of systems away from equilibrium. While they may underpin facts like (T1), they do not underpin facts about the rates in which systems approach equilibrium, about the kinds of states they pass through on their way to equilibrium, or about fluctuation phenomena.

I suggest that the limitations of these accounts are a symptom of what they are aiming at. By focusing on recovering aspects of thermodynamics, those contributing to the literature have merely been in the business of recovering a few qualitative facts. To remedy this situation, I suggest moving the discussion away from these accounts and onto understanding why the techniques physicists actually use to model the behaviour of

nonequilibrium systems are effective. By understanding the success of these techniques, we will not only be able to underpin qualitative facts like (T1) but we will also be able to underpin many of the important quantitative facts that typicality accounts cannot. I also take some of the first steps in this direction by outlining and attempting to rationalise a technique commonly used by physicists. The approach takes its cue from the theory of Brownian motion.

C2.5 PHILOSOPHY OF THE PHYSICAL SCIENCES

Wednesday, August 5 • 14:30–16:30
Main Building, Room 6

Causal Sets and Discrete Linear Structures

Hudetz Laurenz
Department of Philosophy (KGW), University of Salzburg, Salzburg, AUSTRIA

This talk examines how causal set theory is related to Tim Maudlin's theory of linear structures, which is an alternative to standard topology and has been developed in Maudlin's recent monograph New Foundations for Physical Geometry (2014). The theory of linear structures and causal set theory share their main motivations: (a) both are intended for analysing discrete spacetime structures, and (b) both are based on the fact that the class of future-directed continuous timelike curves in a strongly causal

Lorentzian spacetime determines its topology (cf. ?Hawking, King & McCarthy (1976), Malament (1977)). Although the theories are very similarly motivated, it has not yet been investigated how they are related to each other. The principal aim of this talk is to provide a thorough answer to this question. My main theorem says that the category of causal sets is isomorphic to a specific subcategory of the category of linear structures, namely to the category of full locally finite one-way linear structures. It follows that causal set theory can be done within the more general framework of Maudlin's theory of linear structures. Moreover, I show that the outward topology (as defined by Maudlin) of a given locally finite one-way linear structure is identical to the Alexandrov topology on the corresponding causal set. This ties in nicely with the fact that the manifold topology of a strongly causal Lorentzian spacetime also coincides with its Alexandrov topology. Finally, I point out that these results might be relevant for treating the inverse problem of causal set theory. Whether a solution can actually be achieved using the theory of linear structures is an open question. It seems to be an interesting new strand of research.

Testing typicality in multiverse cosmology

Azhar Feraz
Department of History and Philosophy of Science, University of Cambridge, Cambridge, UNITED KINGDOM

In extracting predictions from theories that describe a multiverse, we face the difficulty where we must assess probability distributions over possible observations, prescribed not just by an underlying theory, but by a theory together with a conditionalization scheme that allows for anthropic selection effects. This means we need to compare distributions usually consistent with a broad range of possible observations, with actual experimental data. One controversial means of making this comparison (as endorsed, for example, by Vilenkin) is by invoking the principle that we are typical of the reference class implicit in the conjunction of the theory and the conditionalization scheme. In this paper, I quantitatively assess the assumption of typicality in a suite of cosmological settings, employing (what Srednicki and Hartle dub) 'xerographic distributions' to enforce a variety of assumptions regarding typicality. I find that for a fixed theory, the assumption that we are typical gives rise to higher likelihoods for our observations. If, however, one allows both the underlying theory and the assumption of typicality to vary, then the assumption of typicality does not always provide the highest likelihoods. Interpreted within a Bayesian approach to theory confirmation, these results support the claim that when one has the freedom to consider different combinations of theories and xerographic distributions (or different 'frameworks' as Srednicki and Hartle call them), one should find the framework that has the highest posterior probability; and then from this

framework one can infer, in particular, how typical we are. In this way, the invocation of the principle that we are typical is more questionable than has been recently claimed.

Measure, Topology and Probabilistic Reasoning in Cosmology

Curiel Erik
Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universitat, Munich, GERMANY

Although probability is usually defined using measure theory, if one takes a broad-minded view of what counts as "probabilistic" reasoning, then, in many areas of physics, topological concepts and methods also ground much of what it is reasonable to think of as such. Physicists often argue that a property or behavior of interest is typical or generic in a family of possible systems, or is scarce or meagre, and so on, with no serious attempt to make those ideas quantitatively precise, though they clearly are intended to have probabilistic import. Such arguments often use topological considerations with gestures at interpreting the conclusions in measuretheoretic terms so as to justify the intended probabilistic import. It has gone unremarked in both the physics and the philosophy literature, however, that problems arise for probabilistic reasoning in sciences in which infinite-dimensional spaces occur, because of inevitable discrepancies between topological and measuretheoretic structures on such spaces.

In cosmology, the systems one most often focuses on are entire spacetimes, and families of spacetimes usually form infinite-dimensional spaces of a particular kind. And now one comes to the heart of the problem: it is a theorem that infinite-dimensional spaces of that kind do not admit non-trivial measures that harmonize in the right way with any underlying topology. It follows that one simply does not have available the kinds of reasoning normally employed to draw even qualitative conclusions about the likelihoods of properties or features or behaviors of spacetimes. To be clear, I do not claim that it is not possible to draw well grounded conclusions about such likelihoods, only that arguments of the standard forms cannot, not even in principle, be made rigorous, and so conclusions based on them are prima facie suspect, and should be treated with far more caution and skepticism than is common in the physics and philosophy literature.

Bayesian Perspectives on the Discovery of the Higgs Particle

Dawid Richard
Philosophy, LMU Munich, Munich, GERMANY

The discovery of the Higgs particle in 2012 was an important instance of empirical confirmation in high energy physics. One interesting aspect of the Higgs discovery was the fact that physicists were very confident about the existence of a Higgs particle already before it was empirically discovered. The talk addresses the question in which way this specific situation influenced the understanding of empirical testing in the given case. Specifically, it is analysed whether and to what extent that influence can be understood in terms of a Bayesian perspective on data analysis.

Data analysis in high energy physics is generally carried out within a frequentist framework. Bayesian elements of data analysis do sometimes occur in the field. However, Bayesian analysis unsually is not used to account for genuine a priori trust in the theory under scrutiny. Typically, generic prior probabilities are deployed to exclude experimental outcomes in advance which are deemed physically meaningless. In the case of the Higgs search the use of prior probabilities is more implicit but closer to the genuine spirit of Bayesian reasoning: it relies on non-generic prior probabilities which actually represent the trust in the Higgs hypothesis before empirical testing. The trust in the existence of a Higgs particle is accounted for when assessing the so called Look Elsewhere Effect (which denotes the way in which the testing of wide parameter ranges affects the evaluation of the actual significance of a signal at one specific parameter value.) This amounts to taking seriously prior probabilities in a specific context. The talk investigates how the described line

of reasoning can be understood within an overall Bayesian framework. It is shown that a Bayesian perspective provides a coherent understanding while a rigidly frequentist analysis of the described line of reasoning runs into consistency problems.

C2.6 PHILOSOPHY OF THE PHYSICAL SCIENCES

Friday, August 7 • 11:00 –13:00
Main Building, Room 8

Information, entanglement and causation

Lombardi Olimpia
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According to the physical interpretation of the concept of information -very usual among physicists and communication engineers-, information is a physical item that, like other physical quantities, can be stored, accumulated, generated in one place and transmitted to another place, and transformed from one form to another form. To the extent that it is a physical item, information needs a signal acting as its physical carrier, and can only be transferred through interactions.

In spite of its wide diffusion, this interpretation is challenged by "quantum" information: entanglement-assisted communication shows that, although mere correlation is not sufficient for communication, the need of a physical signal for the transmission of information is a too strong requirement. The traditional physical view leads to artificial solutions: some authors consider that information can travel backwards in time; others claim that quantum information flows hidden in classical bits.

We want to argue that, even in the case of entanglement-assisted communication, there is no need to discard the physical interpretation of information: it can be retained -without falling into a mere epistemic view of information- without requiring a physical carrier for information transmission. For this purpose it is necessary to support the idea that what happens at the source of information causes what happens at the destination, but with a concept of causality that does not rely on physical interactions or space-time connections. We think that a manipulability account of causation works perfectly in this sense. Intuitively, from this approach the relationship between source and destination is causal because it is potentially exploitable for purposes of manipulation and control. The link between information and manipulability lies in the fact that there is transmission of information whenever we can change the informational content of the destination (effect) by manipulating the source (cause).

On the Problem of Truth Valuation in Quantum Mechanics in Light of Category Theory

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Zafiris Elias
Department of Logic, Eotvos University, Budapest, HUNGARY

The semantics underlying the non-Boolean logical structure of Hilbert-space quantum mechanics involves an inherent ambiguity with respect to the classical binary true/false value assignments, rigorously expressed, for the first time, by Kochen-Specker's theorem. According to this, for any quantum system associated to a Hilbert space of dimension higher than two, there does not exist a two-valued, truth-functional assignment $h: L(H) \rightarrow \{0, 1\}$ on the set of closed linear subspaces, $L(H)$, interpretable as events or elementary quantum mechanical propositions, preserving the lattice operations and the orthocomplement. It should be noted, however, that although the preceding Kochen-Specker result forbids a global, absolute assignment of truth values to quantum mechanical propositions, it does not exclude ones that are contextual. Of course, the formalism of quantum theory does not imply how such a contextual valuation might be obtained, or what properties it should possess.

To this end, we apply the powerful methods of categorical topos theory, which directly captures the idea of structures varying over contexts, thus providing a natural setting for studying contextuality phenomena. Specifically, the research path we propose implements the intuitively clear idea of probing the global structure of a quantum algebra of events (or propositions) in terms of sheaves of local Boolean frames, associated with variable measurement contexts of quantum observables, thus forming Boolean localization functors. The category of sheaves is a topos providing the possibility of applying the powerful logical classification methodology of topos theory with reference to the quantum world. In particular, we show that the topos-theoretic representation scheme of quantum event algebras by means of Boolean localization functors incorporates an object of truth values, which constitutes the appropriate tool for the definition of quantum truth-value assignments to propositions describing the behaviour of quantum systems. Effectively, this category-theoretic representation scheme avoids the semantic ambiguity with respect to truth valuation that is inherent in conventional quantum mechanics by inducing an objective contextual account of truth in the quantum domain of discourse. The philosophical implications of the resulting account are analysed. We argue that it subscribes neither to an epistemic nor to a relative notion of truth. Such an account essentially denies that there can be a universal context of reference or an Archimedean standpoint from which to evaluate logically the totality of facts of nature.

C2.7 PHILOSOPHY OF THE PHYSICAL SCIENCES

Thursday, August 6 • 11:00–13:00
Main Building, Room 6

A diachronic perspective on the structure of quantum lattices

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In quantum mechanics, the mathematical expression of different measurements is given by the commutator between operators. If two measurements are incompatible, the commutator between the projectors associated with the measured properties is nonzero. In this case, the lattice constructed from those properties has non- Boolean features. On the contrary, if the commutator is zero, the lattice of properties is Boolean. On the other hand, the works of Kiefer and Polarski show that, the study of the evolution of quantum systems in the Heisenberg picture (where operators evolve) leads to an interesting result: under certain conditions, the evolution is such that initially the commutator between two operators is not zero, but after some time it becomes zero.

In this presentation we will study the Heisenberg evolution from the point of view of the lattices of properties. We will show that, under very specific physical conditions, the initial lattice is non-Boolean and the final lattice is Boolean. This means that, in the span between the initial time and the final time, the lattice evolves under a dynamics that allows us to study the Boolean limit of non-Boolean lattices. We will analyze this phenomenon both from a general point of view and in some specific physical examples where the evolution of the lattice can be computed.

Additionally, the lattice structure can be characterized in terms of distributive inequalities, which become equalities in the Boolean case. If we express these inequalities in terms of commutators and introduce the dynamics of commutators from Kiefer and Polarski, then we can consider how the logical structure approaches a Boolean lattice by analyzing how the distributive inequalities evolve. The analysis of the evolution of inequalities and lattices amounts to the study of the diachronic features of quantum logic structures, a matter scarcely explored to date.

Common cause closedness in orthomodular lattices

Kitajima Yuichiro
College of Industrial Technology, Nihon University, Narashino, JAPAN

Reichenbach proposed the principle of common cause to characterize the asymmetry of time. According to this principle, for any correlated two events which are causally independent, there must exist a common cause of them. He provided precise mathematical formulation of this statement. It has been extensively discussed, and some counterexamples of this principle were provided. But it is difficult to falsify the common cause principle by providing some counterexample because a common cause may be hidden from the perspective probability measure space. Although this principle asserts that the presence of a correlation of two events implies the existence of a common cause of them, it does not require that the common cause of the two correlated events A and B belongs to the probability measure space in which A and B have been found. Thus one cannot conclude that this principle is not valid by showing a probability measure space which lacks a common cause of correlated events because there may exist a larger space which is consistent with the original one and contains a common cause of any correlated events. Such a larger space is called common cause closed. Common cause closed probability measure spaces provide positive confirming evidence for the validity of this principle. Therefore, it is an important problem to determine when a probability measure space is common cause closed. In this talk, we investigate a general probability space with an orthomodular lattice and probability measure, and give a necessary and sufficient condition for common cause closedness in the case when an orthomodular lattice is a Boolean algebra or a non-commutative von Neumann algebra.

Popper School Methodological Disproof of Quantum Logic

Meyer Steven
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The Von Neumann/Birkoff axiomatization was strongly criticized from the beginning. The best, but so far mostly ignored, criticism was made by Emmy Noether student Grete Hermann in 1935 (Herzenberg, C. arXiv:0812.3986[physics.gen-ph], 2008). After briefly discussing criticisms by quantum physicists, the main section of the paper looks in detail at the criticism of formalized physics from the Popper School. Karl Popper falsified quantum logic from probability theory ("Birkoff and Von Neumann's Interpretation of QM", Nature 219, 1968, 682-685). Paul Feyerabend criticized quantum logic using philosophical analysis that he characterized as similar to Bohr's. Imre Lakatos showed alternatives to 20th century view that truth can only be generated from axioms. The problem with quantum logic is illustrated by tracing the initial reviewers reaction to Popper's paper available in the Karl Popper Archive. The extensive Feyerabend anti quantum logic arguments from the archive are also discussed.

Patrick Suppes, in his 1974 Popper Living Philosophers Volume contribution, seems to agree that quantum logic is wrong or at least poorly defended, but still maintains only axiomatized theories of physics are possible and suggests some as yet undiscovered axiomatization of QM will solve the problem with quantum logics (Schlipp, Vol. 14, 767-774). Surprisingly, Suppes' admission of incorrectness somehow became almost total acceptance of axiomatized quantum logic. Quantum logic became an axiom itself beyond criticism.

The paper then discusses Victor Kraft's Popper Schlipp volume contribution, in which he explains schools and shows Popper's continuation of Vienna Circle type schools (Vol. 14, 185-204). The next section of the paper connects the Popper school disproof of quantum logic to the role of mathematical rigor in physics. The attitude of physicists is complex. It probably started with Einstein's 1921 lectures on geometry. "This view of axioms purges mathematics of all extraneous elements" so mathematics "can not predict anything ...". One reason for the lack of disproof of quantum logic is related to Einstein's attitude toward mathematics. Einstein seemed even to the end of his career to believe all physicists could be unified as a theory of differential geometry of space time. This led to his criticism of the entire QM theory as being incomplete, i.e. there is a need to find hidden variables from geometry for Einstein's unification program to succeed. Einstein was mostly superseded by the more field theoretic approaches of Schrodinger and Heisenberg. The paper concludes by discussing two modern theories that depend on quantum logic: engineering quantum computers and computing as physics (sometimes called digital physics).

Generalized Implication in Quantum Logic

Yokoo Tsuyoshi
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In this paper, the implication problem in quantum logic (cf. Hardegree (1979) and Pavicic & Megill (2009) for survey) is addressed. Since Birkhoff and von Neumann's seminal work (Birkhoff & von Neumann (1936)), it has been known that quantum logic lacks the implication connective which satisfies both the modus ponens and the importation-exportaion law. It has been also known that there are exactly six polynomially definable implication candidates that fulfill the criterion called ``locally Boolean" in quantum logic (Kotas (1967) and Kalmbach (1974)). We show that these well-known six polynomially definable implication candidates are numbered by the Beran numbers from 01 to 96 (Beran (1985)) on the Hasse diagram of 96-element orthomodular lattice F2 characteristically (14, 30, 46, 62, 78 and 94 in each 16-element Boolean sublattice) and their non-Boolean patterns are characterized by the notion of contraposition. In quantum set theory (Takeuti (1981)), which is set theory based on quantum logic and crucially depends on the choice of implication, the ZFC transfer principle, which transfers every theorem of ZFC set theory to a valid sentence for the model, is established with respect to the class of implications called ``generalized implication," which includes the above- mentioned six polynomially definable implication candidates as special cases (Ozawa (2007) and Ozawa (2009)). The generalized implication is locally Boolean and not polynomially definable in general. In fact, there are continuously many different generalized implications that are not polynomially definable in quantum logic. The above-mentioned criterion ``locally Boolean" has a physical meaning and is justified by the standard interpretaion of quantum mechanics. As for interpretational problems of values of physical quantities in quantum mechanics, we characterize the generalized implication in relation to observables and beables via the concept of commutator.

C2.8 PHILOSOPHY OF THE PHYSICAL SCIENCES

Thursday, August 6 • 14:30–16:30
Main Building, Room 5

A PBR-like argument for psi-ontology in terms of protective measurements

Gao Shan
Institute for the History of Natural Sciences, Chinese Academy of Sciences, Beijing, CHINA

The ontological status of the wave function in quantum mechanics has been analyzed in the context of conventional projective measurements. These analyses are usually based on some nontrivial assumptions, e.g. a preparation independence assumption is needed to prove the PBR theorem. In this paper, we give a PBR-like argument for psi-ontology in terms of protective measurements, by which one can directly measure the expectation values of observables on a single quantum system. The proof does not resort to nontrivial assumptions such as preparation independence assumption.

Relationalism and Background Independence in Quantum Gravity

Lacina Kamil
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The main problem faced by theories of quantum gravity is the problem of time, which is a direct result of incompatibility of our two main physical theories – General Relativity (GR) and Quantum Mechanics (QM). On the one hand, QM features Newtonian absolute time, a fixed background parameter. On the other hand, GR accounts for time as being a local dynamic parameter – a general spacetime coordinate. This stark contrast proves problematic for formulation of theory of Quantum Gravity, so much so that many physicists and philosophers begin to support the notion of Quantum Gravity without time. One way of approaching the problem of Quantum Gravity without time is Background Independence.

Background Independence is understood as freedom from absolute structures. The proposed presentation will focus on the notion of Background Independence and on its two criteria: temporal relationalism, and configurational relationalism. Analysis of temporal relationalism will focus on the understanding of time as proposed by Leibniz and Mach. Configurational relationalism will be analysed in light of internal space transformations of Gauge Theory.

Drawing on Barbour's relationalism, and Rovelli's relationalism, the main aim of the presentation is establishing whether temporal and configurational relationalism are sufficient conditions for achieving Background Independence, and what problems of time accepting Background Independence leads to at both classical and quantum level.

Reconstruction of The Concept of Physical Quantity: An Epistemological Approach to Understand Weak Value

Sugio Hajime
Philosophy (GCARLS), Keio University, Tokyo, JAPAN

The formulation of quantum mechanics is successful in probabilistic prediction of microscopic phenomena. The theory, however, brought us many philosophical problems, especially problems concerning physical

reality. In fact, it has been thought that the theory never tells us what is going on in the quantum system which is in superposition. However, the situation has been changing. This is because we became able to measure quantum systems weakly without wave function collapse. The measurement, so-called weak measurement, was proposed by Aharonov and his colleagues in 1988. According to weak measurement, it seems that any quantum system has its own value which corresponds to the measurement outcome: weak value. Then some physicists regard weak values as elements of physical reality, because any physical quantity in classical physics has to be assigned its own value anywhere and anytime. The classical concept of physical quantity clearly supports naïve realism, because its value is determined independent of us, and this is why people believe that physical quantities are elements of physical reality. Actually, Einstein and his colleagues derived a sufficient condition for physical reality, which was written by using the concept of classical physical quantity. Of course, in quantum mechanics, the description of physical quantity is changed from the variable to the self- adjoint operator, but as before, it is believed that some basic physical quantities themselves correspond to intrinsic properties of physical objects even though they are not assigned values. However, does physical quantity correspond to physical reality? To give a negative answer, I reconstruct the concept of physical quantity through a mathematical procedure. Then I conclude that physical quantities are conceptual tools to describe physical phenomena and are not elements of physical reality. Moreover, based on the above conclusion, I propose an epistemological interpretation of weak value.

The Probability Problem in Everettian Quantum Mechanics Persists

Dizadji-Bahmani Foad
Philosophy, California State University Los Angeles, Los Angeles, USA

Everettian quantum mechanics (EQM) results in "multiple, emer- gent, branching quasi-classical realities." (Wallace 2010b). The possible outcomes of measurement as per 'orthodox' quantum mechanics, are, in EQM, all instantiated. Given this metaphysics, Everettians face the 'probability problem' - how to make sense of probabilities and recover the Born Rule. To solve the probability problem Wallace has derived a quantum representation theorem. I argue that Wallace's solution to the probability problem is unsuccessful. My strategy is two-fold. First, I examine one of axioms of rationality used to derive the theorem, Branching Indifference (BI). I argue that Wal- lace is not successful in showing that BI is rational. Whilst I think it is correct to put the burden of proof on Wallace to motivate BI as an axiom of rationality, it does not follow from his failing to do so that BI is not rational. After all, one might think that there are other reasons ways to motivate BI. Thus, second, to exclude this pos- sibility, I show that there is an alternative strategy for setting one's credences in the face of branching which is rational and which violates BI. This is Branch Counting (BC). Wallace is aware of BC and has proffered various arguments against it. So the third task of the paper is to show that the arguments Wallace has produced against BC are unpersuasive. I conclude that indeed they are, and that therefore the probability problem in EQM persists.

C2.9 PHILOSOPHY OF THE PHYSICAL SCIENCES

Thursday, August 6 • 17:00–19:00
Main Building, Room 5

Is Bose Einstein Condensation of Trapped Gases a Phase Transition?

Corgini Marco
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The phenomenon of Bose Einstein Condensation (BEC), predicted by Einstein in 1925, corresponds to a macroscopic occupation of a single quantum state (ground state) by a large number of identical bosons (particles whose states are represented by symmetric wave functions).

BEC has been extensively studied, in the framework of quantum equilibrium statistical mechanics, as a kind of second order phase transition associated to the non analyticity, in the so called thermodynamic limit (or bulk limit), of well known thermodynamic averages. In such an approach, the density of particles remains constant while both the number of identical particles and the volume of the region enclosing them tend to infinity.

In this scenario, the theory predicts that at low temperatures and large densities of particles, quantum effects should become essential for the macroscopic behavior of the system. Moreover, under suitable assumptions, for some kind of models (homogeneous non interacting and weakly interacting Bose systems) displaying BEC, the mathematical formalism shows that a spontaneous symmetry breaking associated to local gauge transformations may occur.

The development of highly sophisticated cooling techniques (laser cooling, vaporization) led to experimentally confirm, in the case of diluted atomic gases trapped in magnetic or optical traps, the Einstein's conjecture after 70 years (1995).

Unlike all the previously mentioned theoretical models, trapped gases are inhomogeneous and finite-sized systems. Even more, they can display low dimensional BEC, phenomenon prohibited for infinite Bose particle systems (Hohenberg theorem). Thus, strictly speaking, in the context of this theory, such a behavior of trapped atoms is not a phase transition.

In this work, it will be briefly presented and discussed some attempts to conciliate the general theory of phase transitions with BEC experiments for trapped gases, including recent criticisms, possible consequences on fundamental principles and alternative approaches.

Are Unitarily Inequivalent Representations in Quantum Field Theory Incommensurable Physical Theories?

Lupher Tracy
Philosophy and Religion, James Madison University, Harrisonburg, USA

It has been argued (Arageorgis 1995) (Arageorgis, Earman, and Ruetsche 2002b) (Ruetsche 2011) that the particle concepts associated with unitarily inequivalent representations in quantum field theory are incommensurable. Two arguments are given for the incommensurability. (1) The vacuum expectation value diverges when the total number operator from one representation and the vacuum state from a unitarily inequivalent representation are used. (2) Unitarily inequivalent representations have no density operators in common. Can unitarily inequivalent representations be considered incommensurable theories? One way of characterizing incommensurable theories is that there is no translation scheme that maps states and observables in theory T to states and observables in theory T'. Incommensurability in that sense can be decomposed into two parts: observable-incommensurability and state-incommensurability. There are two frameworks within which to analyze the arguments for incommensurability: canonical quantum field theory and algebraic quantum field theory. In canonical quantum field theory, the relationship between two sets of annihilation and creation operators and their associated states can be expressed through a proper or improper unitary operator depending on whether the representations defined by the two set of operators are unitarily equivalent or unitarily inequivalent. In either case, there is an isomorphism between the sets of states and the sets of creation and annihilation operators. Viewed from the canonical quantum field theory framework, unitarily inequivalent representations are neither observable nor state-incommensurable. Argument (2) is a state- incommensurability argument that relies on concepts in the algebraic quantum field theory framework. However, this incommensurability is undermined because the two sets of states associated with unitarily inequivalent representations are identical if each set of states is closed in the weak*-topology defined on the dual of a C*-algebra.

Do renormalization group methods explain continuous phase transitions?

Palacios Patricia
Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universität München, Munich, GERMANY

The success of renormalization group methods (RGMs) for predicting the behavior of continuous phase transitions is undoubtedly one of the major achievements of quantum field theory. Despite this fact, the question of whether RGMs provide a genuine explanation for these phenomena is still a matter of controversy in the philosophical literature. The reasons for this controversy are mainly two: a) RGMs involve a false assumption: the system is assumed to be infinite. b) The kind of "explanation" that RGMs provide seems to be independent of the causal mechanisms that produce continuous phase transitions. These two aspects conflict not only with mechanistic but also with reductive models of explanation.

In this scenario two different strategies for rescuing the explanatory power of RGMs have been suggested: i) RGMs provide a different kind of explanation that does not correspond to traditional models of explanation. In this direction, Batterman and Rice (2014) propose that RGMs correspond to a minimal model explanation. ii) There is a way of conceiving RGMs as satisfying traditional models of explanation. This is the proposal suggested by Butterfield and Buoatta (2011, 2014) who argue that RGMs satisfy a reductive model of explanation. In this article, I propose an alternative strategy that reconciles these two seemingly contradictory proposals.

I shall make my point in two steps. First, I will show that proposals (i) and (ii) each offer an answer to a different question. While proposal (i) answers a question about the way in which RGMs enable us to predict the behavior of continuous phase transitions after invoking an infinite idealization of the system, proposal (ii) answers a question about what justifies the infinite idealization involved in RGMs. Second, I will argue that we must provide an answer to both of these questions in order to endow RGMs with explanatory power.

Some Considerations Concerning Bohmian Quantum Field Theories CANCELLED

Rossanese Emanuele
Philosophy, Communication and Visual Arts, University of Roma Tre, Maccarese (Rome), ITALY

There are some interesting attempts that try to generalize Bohmian mechanics (BM) to quantum field theory (QFT). One of the main problem is to provide a Bohmian understanding of the creation and annihilation of particles in the context of QFT. Dürr, Goldstein, Tumulka and Zanghì (2004) and (2005)proposed a possible formulation of a Bohmian QFT that seems to solve this issue. However, even if this

result is achieved, there are still more fundamental problems that might undermine the whole project. Many physicists and philosophers of physics claim that BM has a particle (primitive) ontology. In particular, Esfeld, Lazarovici, Hubert, Dürr (2013) claim that the theory is committed only to the positions of particles and a law of motion. Yet, there are several results showing how particles are not the fundamental entities of QFT. Moreover, the notion of localization and that of position are also problematic in the context of QFT. These seem to be two serious difficulties for any Bohmian QFT. I will then discuss the arguments against a particle interpretation of the theory in order to see if they can really hold also against a Bohmian formulation of QFT, which is grounded in a different formalism.

In the final part of the talk, I will also review some interesting attempts to provide a Bohmian QFT with a field (primitive) ontology. In particular, I will discuss Struyve (2010 and 2011)'s proposal.

References: Durr, D., Goldstein, S., Tumulka, R., and Zanghi, N. (2004), Bohmian Mechanics and Quantum Field Theory, in Phys. Rev. Lett., 93, 1–4. Durr, D., Goldstein, S., Tumulka, R., and Zanghi, N. (2005), Bell-Type Quantum Field Theories, in J. Phys. A: Math. Gen., 38, R1-R43. Esfeld, M., Lazarovici, D., Hubert, M., and Durr, D. (2013), The Ontology of Bohmian Mechanics, forthcoming in the British Journal for the Philosophy of Science. Struyve, W. (2010), Pilot-wave Theory and Quantum Fields, in Reports on Progress in Physics, 73, 106001, arXiv:0707.3685v4. Struyve, W. (2011), Pilot-wave Approaches to Quantum Field Theory, in Journal of Physics: Conference Series, 306, 012047, arXiv:1101.5819v1.

C2.10 PHILOSOPHY OF THE PHYSICAL SCIENCES

Friday, August 7 • 11:00 –13:00
Main Building, Room 12

Entanglement and Probability

Hintikka Jaakko
Philosophy, Helsinki Collegium for Advanced Studies, Helsinki, FINLAND

Why cannot the behavior of entangled particles be explained in terms of shared attributes? Allegedly because of Bell's inequality. But if that inequality is merely a mathematical truth, it cannot have any factual consequences. Hence we should look for a better mathematics, including new logic and new concept of probability, as John von Neumann did, unfortunately unsuccessfully. By now we have available a better logic in the form of independence-friendly (IF) logic which unlike traditional first-order logic captures mathematicians' actual conceptual practice. It creates a more flexible probability calculus in which Bell's inequality fails. This removes all obstacles to local realism and hence vindicates Einstein vs. Copenhagen interpretation.

A discussion about the ontological commitments of quantum information theory

Holik Federico
Facultad de Ciencias Exactas, CONICET-Universidad Nacional de La Plata, La Plata, ARGENTINA
Lombardi Olimpia
Facultad de Ciencias Exactas y Naturales, CONICET-Universidad de Buenos Aires, Buenos Aires, ARGENTINA

At present it is usually assumed that quantum information is inextricably linked to quantum mechanics. The fact that non-orthogonal quantum states cannot be distinguished by single measurements is sometimes taken as a proof of this link. Thus, some authors consider quantum information as information represented in non- orthogonal states. Nevertheless, there are classical models which can be reformulated in such a way that non- orthogonal states appear. As some authors stress, certain features traditionally considered as peculiarly quantum can be recovered in a formalism that deals with classical mixed states defined as probability measures over a classical phase space (or in the Hilbert space formalism of classical statistical mechanics).

In this work we will consider 'Quantum Models of Classical Systems' (QMCS), that is, classical systems that are modeled by means of mathematical descriptions that simulate quantum properties. They can be used to reproduce interference phenomena and other quantum features such as entanglement and contextuality. We will focus in the so-called "elastic band model", in which the probabilities are non-Kolmogorovian, and the quantum to classical transition depends on the value of a continuous parameter. We will also discuss recent experiments based on the study of non-coalescent liquid droplets coupled to pilot waves in the surface of a vibrating liquid. The aim of this article is to study the role of the QMCS in quantum information theory from an ontological perspective. In particular, we will address the following question: how necessary are quantum systems in order to reproduce the main features of what is called quantum information theory? We will tackle the task by analyzing some examples of QMCS and their capability of reproducing quantum information protocols.

A Path Integral Treatment of an EPR Experiment: Insights into the Nature of Quantum Nonlocality?

Padden Brian
Philosophy of Science, LMU Munich, Munich, GERMANY

We present a path integral version of an EPR experiment and discuss whether an insight about the nature of nonlocal quantum correlations can be gained from it. We take a generalized version of Feynman's path integral account of Klein-Gordon particles and consider the decay of a single particle into two others. An entangled final state is obtained, which displays nonlocal correlations. Looking at the calculation, the correlations seem to be of the completely ordinary kind, resulting from the `common cause' of the decay event. The difficult question is whether this interpretive conclusion is justified. The Feynman path integral is usually not used for interpretational analysis since the oscillatory nature of the paths' contributions, e^{iS}, makes putting a probability distribution on the space of paths problematic. But in cases in which interference effects are absent or unimportant, the probability distribution found is intuitively pleasing - and that is the case here. If we accept this interpretation, we can tell a nice story: in each history, the decay occurred at some spacetime point, from which the two new particles departed in opposite directions. The nonlocal correlations found later on would then simply be a relic of this `common cause' - a totally ordinary effect. Should we accept this explanation? The story we would like to tell about the experiment is intuitively plausible and, moreover, if one were to check it with intermediary measurements in like trials, one would find that the story is consistent. However, we know that this interpretive framework we are using is problematic, both due to its lack of generality in the face of interference effects and also because causality is difficult to analyze in the Feynman path integral. We advocate seeing this as an important insight, but one whose problems must be further studied.

Separate common causes explanations for EPR-correlations - an almost-no-go result.

Godziszewski Michal Tomasz
Department of Logic, University of Warsaw, Warszawa, POLAND
Placek Tomasz
Department of Epistemology, Jagiellonian University, Krakow, POLAND
Wronski Leszek
Department of Epistemology, Jagiellonian University, Krakow, POLAND

One diagnosis of Bell's theorem is that its premise of Outcome Independence is unreasonably strong, as it postulates one common screener system that purports to explain all the correlations involved. This poses a challenge of constructing a model for quantum correlations that is local, non-conspiratorial, and has many separate screener systems rather than one common screener system. In particular, the assumptions of such models should not entail Bell's inequalities. We prove that the if a model described exists, then there exists a local common screener system model for quantum correlations breaking Bell's inequalities. Such a model, however, is necessarily conspirational. Additionally we present the state of research concerning the project of proving the non-existence of local, non-conspiratorial separate-ss models.

C2.11 PHILOSOPHY OF THE PHYSICAL SCIENCES

Friday, August 7 • 14:30–16:30
Main Building, Room 5

Irreversibility and Teleology in Physics

Firt Erez
Philosophy, Haifa University, Tel Aviv, ISRAEL

The aim of this paper is to examine whether irreversibility can be truly thought of as a mark of teleology, from a physical point of view. This is a two-step investigation: First, I shall examine whether irreversibility plays an actual role in our fundamental physical theories. Second, if indeed it does, I shall examine whether this role can be thought of as teleological. To achieve these aims, I introduce several teleological characteristics which are suitable for the study of teleology in physical theories.

Our experience teaches us that many physical processes are irreversible; these phenomena are all described by the laws of thermodynamics, which manifest this directionality of time. I therefore begin the discussion with the laws of Thermodynamics and Statistical Mechanics, which is commonly considered to be the fundamental physical theory underlying Thermodynamics. From this point on, I discuss irreversibility and teleology in the context of the controversy revolving around the Past Hypothesis - the special assumption introduced to resolve the conflict between the time-asymmetric laws of thermodynamics and time-symmetric laws of Statistical Mechanics - and the temporal nature of our physical theories.

First, I approach the issue from the time-symmetrical point of view. I discuss the option of a Gold Universe and a Future Hypothesis, as they appear in Huw Price's(*) suggestion. Following that, I discuss the time- asymmetrical approach, according to which the apparent asymmetrical nature of time is due to the asymmetrical nature of our most basic physical theories (e.g. the GRW formulation of Quantum Mechanics). In summation, I discuss the role irreversibility plays within these two temporal approaches, and the relation between irreversibility and teleology.

(*) Price, H. (1996). Time's Arrow and Archimedes' Point. Oxford University Press.

Quantum mechanics (QM) and the troubles with identity

Krause Décio
Philosophy, Federal University of Santa Catarina, Florianópolis, BRAZIL

The literature on the foundations of physics discusses whether QM violates Leibniz's Principle of the Identity of Indiscernibles (PII). PII, in some of its forms, is a theorem of classical logic; since QM is standardly formulated in a classical mathematical setting, which presupposes classical logic, any violation of PII entails a contradiction. In short, PII is part of the standard theory of identity of classical logic, entailing that there cannot be indistinguishable but not identical objects, and this would apply also to quantum objects (q-objects). So, most philosophers prefer to keep PII intact and speak only of some form of quantum indistinguishability instead. In presupposing this, bosons in a same state would be indistinguishable in the sense of obeying Bose- Einstein statistics, but yet discernible by the underlying logical apparatus (being more than one, they are necessarily distinct, and present a difference, at least in principle). This conclusion is unavoidable within the classical logico-mathematical schema. We can circumvent this conclusion by understanding that identity, as understood by classical logic, is a concept that can be ruled out in regarding q-objects, for all we need is a weaker concept of indiscernibility (and its negation, "discernibility"). Bosons in the same quantum state would be simply indiscernible and, when they present distinction, they would be discernible, but discernibility does not imply more than numerical difference, so as indiscernibility does not imply sameness. And this occurs also when we have a collection (with cardinal greater than one) of such entities, as in a BEC: this does not entail that the involved entities do present identity conditions. They may be taken simply as a crowd of q-objects without any distinction. All we need is a logico-mathematical apparatus for sustaining such a view, and we have that; it is called quasi-set theory, presented at the CLMPS for the first time.

Can analogies make us understand quantum mechanics – finally ?

Vervoort Louis
CIRST, University of Quebec at Montreal (UQAM), Montréal, Québec, CANADA

Recently experiments by a group of physicists based in Paris have shown that fluid systems (oil droplets bouncing on vibrating oil films) can strikingly mimic quantum systems. A whole series of phenomena has been observed on such walking oil droplets that are analogous to quantum phenomena (including double-slit interference, quantization of angular momentum, Zeeman splitting etc.). These analogies are striking because macroscopic fluid systems and microscopic quantum systems are usually thought to be quite disjoint. At the same time they suggest that, contrary to what is generally believed, an intuitive understanding of quantum mechanics is maybe not beyond reach. These experimental analogies also point to the possibility that formal analogies between hydrodynamics and quantum mechanics could exist and be further revealed.

In this talk I first will present the experimental analogies with a view on their philosophical import. Then I will show that there indeed exists, on a more fundamental and formal level, a striking analogy between the Schrödinger equation and fluid-mechanical equations. Finally I will discuss the potential of interpreting the whole of quantum mechanics as a kind of fluid-dynamical theory; to that end I will use results by E. Madelung, D. Bohm and J. Vigier. In such a theory a particle is a singularity in a fluid-like medium (a field, the ether, the physical vacuum,...). Of course, the construction of a fluid-dynamical theory for quantum phenomena is not yet finalised; but in view of the Paris experiments and the theoretical results presented here, this effort seems to deserve wider attention: it would rid quantum mechanics of many of its conceptual riddles (besides allowing to devise new experiments). Finally I will point out the links with theories based on a stochastic, Brownian sub- quantum reality, recently studied by G. Bacciagaluppi.

The Equivalence Principle is a Criterion of Identity

Samaroo Ryan
Department of Philosophy, University of Bristol, Bristol, UNITED KINGDOM

In 1907 Einstein had an insight into the gravitational interaction. That insight has been formalized in a principle called 'the equivalence principle'. This is the hypothesis that it is impossible to distinguish locally between immersion in a homogeneous gravitational field and uniform acceleration. The principle motivated a critical analysis of the 1905 inertial frame concept, and it was decisive in Einstein's argument for a new conception of inertia.

Most work on the equivalence principle has focused on challenges that arise in the formulation of a statement of the principle and on the proper understanding of its scope of applicability. Other work focuses on conceptual tangles that the principle supposedly raises. Still other work examines the principle with an eye to quantum theory. This work is important. But it largely neglects the methodological analysis of the principle. A methodological analysis must consider two questions: What kind of principle is the equivalence principle? What is its role in the conceptual framework of gravitation theory?

I offer a new account of the methodological role of the principle. I argue that the principle should be understood as a criterion of identity; it grounds our recognition that two previously distinct concepts of motion are identical. The equivalence principle functions as a criterion for identifying the motion of a classical inertial frame with that of a locally freely falling one. It is the provision of this criterion of identity, moreover, that governs the application of the geometry of variable curvature in Einsteinian gravitation.

This work extends Demopoulos' (2013) analysis of the notion of a criterion of identity and its significance for distinguishing between applied mathematical theories that have and do not have factual content. I aim to show that his proposal illuminates the methodological role of the equivalence principle.

C2.12 PHILOSOPHY OF THE PHYSICAL SCIENCES

Saturday, August 8 • 13:30–15:30
Main Building, Room 13

Quantum Mechanics and Scientific Realism: restoring a misconceived relation

Panagiotatou Maria
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The paper aims at examining the controversial issue of a realist approach of quantum theory. To this end, it is maintained that the novel character of quantum theory appears 'paradoxical' only when it is contrasted to our classical intuitions and prejudices; however, when independently evaluated, it manifests obvious explanatory virtues. Secondly, it is argued that the notion of 'local realism', as it emerges from the analyses of Bell and Kochen-Specker theorems, has significantly influenced our view about realism and quantum mechanics. Finally, after the exposition of the current view of scientific realism, the paper defends the thesis that the realist approach to quantum mechanics is possible despite its unquestionable novel elements and even if the issue of its interpretation, for some philosophers or scientists, is still disputed.

The epilogue draws the conclusion that quantum physics succeeded in changing our view of the world, yet did not substantially change our philosophical outlook about scientific theories, whether realist or antirealist.

(Dis)Solving the Measurement Problem

Pättiniemi Ilkka,
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

In this paper I will argue that the Measurement Problem in Quantum Mechanics is a pseudo problem, caused by an inappropriate characterization of the measurement apparatus. Following Ladyman and Ross's thesis of the scale relativity of ontology, their remarks on the Measurement Problem (Everything Must Go, OUP: London, 2007), and also more traditional philosophical work on vagueness, I will argue that the measurement apparatus cannot be represented by a pure quantum state. Therefore the coupling of a Quantum Mechanical system S and an apparatus A will not be represented by an entangled state. Thus after a measurement A will not be in a superposition, but will rather be better represented by a mixed quantum state. As the indeterminacy here is epistemic in nature, the Measurement Problem will not get off the ground.

On the notion of a-spatiotemporal beables in quantum gravity, or: Can we dispense with space and time as fundamental categories?

Vassallo Antonio
Philosophy, University of Lausanne, Lausanne, SWITZERLAND

One of the most remarkable contentions in the research for a theory of quantum gravity (QG) is that spacetime might not be fundamental, but "emergent" from an ontological ground floor made up of a-spatiotemporal elements of reality. However, there is some philosophical resistance over this view based on the fact that such alleged building blocks of spacetime are usually represented as quantum superpositions of abstract mathematical objects (e.g. spin-network states in loop QG). Given this fact, it is difficult to provide these elements with a sharp metaphysical characterization. With this respect, it is not sufficient to say that spacetime simply emerges from a probabilistic cloud of a-spatiotemporal elements, since any sufficiently worked out account of emergence (e.g. in terms of causality, supervenience, or ontological grounding) heavily relies on pre-existing spatiotemporal notions. On the other hand, such a skeptical attitude is usually accused of being unreasonably attached to intuitions, and seeking to force a "folk" picture in terms of outmoded Aristotelian categories - such as space and time - upon modern physics.

The aim of the paper is to enter the above sketched debate by considering the question whether a metaphysics that acknowledges the primacy of physics over the special sciences could dispense with space and time as fundamental categories, and by what means it might do so. A special emphasis will be put on the notion of local beable and its role in bridging ontological and empirical aspects of a physical theory. In particular, it will be discussed what kind of modifications such a concept should undergo in order to fit the QG context. Finally, a tentative proposal will be put forward concerning the minimal metaphysical requirements that beables for a theory of QG should meet in order to be considered genuine elements of reality as opposed to mere abstract elements of the formalism.

Chemistry, Paradigms, and a View of Epistemic Pluralism: To the Issue of the Nature of Disagreements in Philosophy and in Science

Vihalemm Rein
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Chemistry, especially its historical practice, has in the philosophy of science in recent decades attracted more and more attention, influencing the turn from the vision of science as a timeless logic-centred system of statements towards the history- and practice-centred approach. The problem of pluralism in science has become a popular topic in that context. Hasok Chang's 'active normative epistemic pluralism' manifested in his book, pursuing of integrated study of history and philosophy of science (Chang 2012), has provoked quite a widespread debate. Chang's work has been welcomed as a very interesting and highly stimulating, including in the sense that the author's conception inspires to point out disagreements with him, encouraged by his positive attitude to disagreements—this goes together with his pluralism—in philosophy and in science. It provides a good opportunity to discuss the topical issue of the nature of disagreements. The differences among disagreements in different domains have been pointed out in the disagreement literature. It has been noticed that in mathematics and science consensus establishes more clearly than in philosophy where it remains largely unachievable (Kornblith 2010). However, this conclusion is derived in the context of traditional logic- centred view of science. The aim of this paper is to consider the different nature of disagreements in science and in philosophy in the context of the history- and practice-centred approach. The analysis is focused on the critique of the received view of the Chemical Revolution which played the central role in Chang's becoming a pluralist about science. Unlike Chang, however, a modified Kuhnian paradigm-conception of science and scientific revolutions is defended.

References: Chang, H. (2012). Is Water H2O? Evidence, Realism and Pluralism. Dordrecht et al.: Springer. Kornblith, H. (2010). Belief in the Face of Controversy, pp. 29-52. In: Feldman, R. & Warfield, T. A. (eds.), Disagreement. Oxford: Oxford University Press.

C2.13 PHILOSOPHY OF THE PHYSICAL SCIENCES

Wednesday, August 5 • 17:00–18:30
Main Building, Room 16

Likelihood and Confidence in the IPCC's Uncertainty Framework

Helgeson Casey
Philosophy, London School of Economics, London, USA

The prevalence of deep uncertainty in climate science — combined with the urgency and political controversy surrounding climate change — has pushed the IPCC (Intergovernmental Panel on Climate Change) towards ever greater focus on faithfully characterizing climate change uncertainties. Meanwhile, the scale of IPCC assessments (with hundreds of lead authors from dozens of disciplines) makes it a challenge to maintain consistency in communicating uncertainty across chapters and working groups. The result is the IPCC Uncertainty Guidance Note, a document outlining the language and framework that authors are to use in expressing uncertainties in IPCC assessment reports — uncertainties associated, e.g., with temperature and sea-level projections, or health and agricultural impacts. The framework is novel primarily in its inclusion of second-order uncertainty in the form of "confidence" assessments. Findings are expressed by assigning a probability, or probability range, to an event (what the guidance calls "likelihood") and then assigning a qualitative level of confidence to that likelihood. Confidence assessments reflect the level of scientific understanding behind the probabilities. Applying the framework requires managing a trade-off between uncertainty in likelihood and confidence; e.g., does one report that a given event is "likely" (66-100% chance) with medium confidence, or that the same event is only "more likely than not" (50-100% chance) but with high confidence? I examine the conceptual constraints on relocating uncertainty between the likelihood and confidence assessments. These turn out to be minimal, and rightly so: whether precision in the likelihood interval can be exchanged for greater confidence (and at what rate of exchange) is determined by the particulars of the supporting evidence. Using examples from the Working Group 1 contribution to the Fifth Assessment

Report, I suggest where such trade-offs can be epistemically appropriate. Where multiple likelihood/confidence combinations are permissible, the needs of decision makers can help narrow the options.

Epistemic and institutional challenges posed by the provision of climate services

Hidalgo Cecilia
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Contemporary research initiatives that address the challenge of producing relevant knowledge on global change make mandatory not only to integrate social sciences perspectives into the understanding of linked biophysical and social processes, but also to clarify the conditions in which knowledge may turn into action. An eloquent illustration is provided by the concept of "climate services" recently adopted by the World Meteorological Organization (WMO) as a synthesis of the will to produce climate information and knowledge that matches the needs and expectations of different profiles of actors and climate-sensitive sectors. Two main senses of co-production can be elicited in current claims for scientific knowledge able to support adaptation decisions and provide straightforward estimates of uncertainty. One points to interdisciplinarity and

social participation, to the articulation of the talents, perspectives and values needed to produce robust knowledge. The other highlights the intertwined transformations of identities, institutions, languages and discourses involved in the process of collaboration. Both senses are in use in scientific and operational institutions devoted to climate issues, nowadays eager to inform public anda private decision-making. What are the epistemic features of this new approach to knowledge production? How can philosophy of science help to conceptualize these new trends of research practices now emerging and consolidating? The paper analyzes the process of scientific and institutional collaboration triggered by the recent creation of a Regional Climate Center in South Eastern South America by the WMO and elaborates on the central role of scientific knowledge in its formation. The opportunities and difficulties involved in the design of interactive and horizontal forms of research and intervention, far beyond integrated modeling, are deployed as both a declaimed shared goal and a source of dis/encounter.

C3

C3.1 PHILOSOPHY OF THE LIFE SCIENCES

Tuesday, August 4 • 11:00–13:00
Main Building, Room 4

Evolutionary explanations

Hiekel Susanne
Insitute for philosophy, University Duisburg-Essen, Essen, GERMANY

Evolutionary explanations In the philosophy of biology, two opposing interpretations of Darwin's ‚one long argument' are defended. The first interpretation, advocated for example by Michael Ghiselin or Michael Ruse, understands the argument in terms of a Hempelian account of historical explanation. The second interpretation, advocated by Stephen J Gould, emphasizes the historical dimension of the argument and regards it as implying a narrative historical methodology. According to the Hempelian account, a scientific explanation is only given if the event which is to be explained can be subsumed under a law-like universal hypothesis. According to Ghiselin and Ruse, the argument of the 'Origin of species' is to be reconstructed in that way. Gould, by contrast, stresses that evolutionary events are "particulars of history, rather than necessary expressions of law" (Gould, 2002, p.1333). With this conflict in the background, two different, more or less tacitly presupposed methodologies of historical explanations – the Hempelian account and Arthur C. Danto's narrative account of historical explanation – are presented in general and then transferred to an explanation of an evolutionary event: the endosymbiosis. According to the theory of endosymbiosis, recent eukaryotic cells evolved because of symbiosis events that led to the development of the organelles (mitochondria and plastids) of eukaryotic cells. More specifically, I argue that the Hempelian account – apart from the fact that it faces general difficulties such as the problems of overdetermination, of full description and of prediction – falls short of capturing a specific aspect of natural history: the particularity of evolutionary events. By contrast, a narrative account which draws on Arthur C. Danto's explanation model avoids the problems of the covering law model and does justice to this aspect of natural history. Consequently, a historical explanation of evolutionary events is defended, which is in tune with Danto's historical explanation.

References: Danto, Arthur C.: Narration and Knowledge. (New York: Columbia University Press, 2007) Ghiselin, Michael: The Triumph of the Darwinian Method (Berkeley: University of California Press, 1969) Gould, Stephen Jay. The Structure of Evolutionary Theory (Cambridge Mass., London, Belknap Press of Harvard University Press, 2002) Hempel, Carl G.: The Function of General Laws in History. In: Patrick Gardiner (Hrsg.): Theories of History (New York: The Free Press, 1959) Ruse, Michael: The Darwinian Revolution: Science Red in Tooth and Claw. (Chicago: University of Chicago Press, 1979)

The plant and the pollinator tale: or how to take teleology seriously and yet not be a Lamarkian?

Ongay de Felipe Iñigo
Fundación Gustavo Bueno., Fundación Gustavo Bueno, Oviedo, SPAIN

The topic this paper shall address is the connections between teleology , behavior and selection within the context of Evolutionary Theory. I start off by considering how Darwin's initial account of Evolution by Natural selection did not take teleology and Evolution to be so disjointed from one another as later architects of the Synthetic Theory pictured them to be. Secondly, I shall raise a philosophical question concerning the role of teleology in current interpretations of Evolution and Natural Selection. I shall contend that if any sort of teleology is excluded from Biology the concept of Selection would cease to make sense in explaining evolutionary processes. Much debate has recently arisen in Philosophy of Biology over the status of Selection as a natural force with various philosophers and biologists alike arguing that Natural Selection is not to be interpreted as a real cause directing the evolutionary change of populations. I contend that in absence of teleology they are actually right. I will suggest that Natural Selection stands or falls with teleology. In turn, I defend, if there is a place for teleology in our understanding of Evolution by means of considering the ethological operations of animal organisms in the wild as the real agents guiding the process of organic change, the concept of Selection would be epistemologically safe. Finally I will discuss specific cases of pairwise coevolution I which different individuals actively select one another thus guiding evolution by way of their behavior.

Explanatory unification and statistical interpretations of natural selection and drift

Petkov Stefan
Institute of Science, Technology and Society, Tsinghua University, Beijing, CHINA

The debate between the dynamic and the statistical interpretations of natural selection is centered on the question: Are explanations that employ the concepts of natural selection and drift reducible to causal explanations? The proponents of the statistical interpretation answer negatively and also claim that selection/drift arguments in evolutionary biology are explanatory but remain unclear on where does the explanatory power come from. The proponents of the dynamical interpretation answer positively and try to reduce selection/drift arguments to some form of causal explanations.

I'm defending a statisticalist position. My claim against causal analyses is that they are bound to use current accounts of causality in a very lose manner or have to violate them in some of their core conditions. In order to defend my claim I'm focusing on explanatory power. I'm proposing to convey selection/drift explanations within the unificationist model of scientific explanations. Thus selection/drift explanations' explanatory power does not have to come from "getting the causal story right" but instead is a result of succesful theoretic unification. In turn the causal notion that is admissible within selection/drift explanatory arguments is exactly the type of causation that proponents of the unificationist model believe will appear as a by product of succesful theoretic unification. Thus the inconsistency between the notion of "vernacular fitness" as causal process and "predictive fitness" as a statistical artefact disappear if we note that both concepts do not violate the general explanatory pattern of Darwinian evolution and are a result of consistent additions to the general Darwinian explanatory pattern.

Finally I'm going to give more substance to my discussion by an interpretation of the recent results of Lenski's long-term experiment with E. coli.

Functions at the interface of biology and technology: synthetic biology, cultivated biology and coevolution

Kingma Elselijn
Philosophy & Ethics, Eindhoven, Eindhoven, NETHERLANDS

Synthetic biology is the designing and building of new biological parts and processes. This in principle allows for the production of completely human-intended, purposefully designed biological organisms. It can be tempting to think of such an organism as organic or biological machines. This places synthetic biology at the interface of the biological and the engineering world – and makes it an interesting perspective from which to reconsider existing philosophical analyses of function.

It is uncontroversial that functional analyses are appropriate in both engineered systems and organisms, but they are analysed differently in each domain; biological functions are often explicitly analysed in terms of natural selected effects, whereas engineering functions often appear the designer's intent or human use. In this context, synthetic biological organisms appear to present a problem: they are not the product of natural selection, so how can they possess biological functions?

In this paper I analyse function judgments in synthetic biological organisms and compare them to cultivated and co-evolved organisms. I argue, first, that functional analysis in artifacts and organisms is far more continuous than one might presume; we can and should bridge the gap that has opened up between biological and technological function. Second, I shall argue that the aetiological analysis of biological function need to be interpreted more flexible than is usually proposed; in a way that encompasses selective and reproductive processes other than natural selection. Moreover I shall argue that agriculture and domesticated animals provide us with reasons for doing this independent from synthetic biology.

C3.2 PHILOSOPHY OF THE LIFE SCIENCES

Wednesday, August 5 • 11:00–13:00
Main Building, Room 17

Evolutionary and Molecular Genes: The Case of Cystic Fibrosis

Shunkichi Matsumoto
Liberal Arts Education Center, Tokai University, Kanagawa, JAPAN

I will discuss the issue of the identification of the gene from a viewpoint of the relationship between evolutionary and molecular genes. Moss makes noteworthy remarks on cystic fibrosis (CF) in the context where he introduces the well-known distinction between Gene-P and Gene-D (Moss 2003), which invited me to conduct some historical as well as contemporary research on the pathophysiological mechanism which makes this lethal genetic disorder happen—especially, the relationship between genotype (mutations) and phenotype (symptoms) governing its onset, by examining several medical articles with the purpose in mind of bringing out how the two types of gene locutions are intertwined in the medical discourse about CF and, eventually, of elucidating what it really means when we speak of "the gene for CF." Followings are the primary points reached: Collins, Riordan, Tsui, and colleagues' historical feat of identifying the cystic fibrosis transmembrane conductance regulator (CFTR) gene in 1989 employed the approach of "reverse genetics," for they had to start to discover it while knowing little about the protein synthesized from it. On the other hand, discovering the mutations that cause pathological symptoms involved the approach of "forward genetics," because it started with the CF phenotypes of patients and then went downward to track down the underlying genotypes (mutations). As for the relationship between evolutionary and molecular genes, first we can point out a kind of conceptual isomorphism between "the gene for X" talk emblematic of evolutionary biology and "the gene for CF" one which is one of the exemplars of molecular biology. Second, and more important, the evolutionary gene concept is viable today even in the modern molecular biology. For instance, in some context, it is a prerequisite for an arbitrary DNA sequence to be identified as a gene (coding region) that it is an evolutionarily conserved (homologous) sequence.

On the Concept of Genetic Distance: the perils of misinterpretation

Tal Omri
Theoretical and Mathematical Biology, Max Planck Inst. for Mathematics in the Sciences, Leipzig, GERMANY

The notion of 'genetic distance' or 'genetic difference' between individuals and between populations has been a focal point of much interest in the scientific literature in the recent decade. But also of much controversy as both empirical and theoretical studies have often arrived at somewhat contradicting claims. For instance, in a widely-cited paper, Rosenberg et al. (2002) conclude from analysis of molecular variance that "The average proportion of genetic differences between individuals from different human populations only slightly exceeds that between unrelated individuals from a single population". On the other hand, Bamshad et al. (2004) have showed that pairs of individuals from distinct populations are often more similar than pairs from the same population, but at the same time stress that for any level of population differentiation "individuals from different populations are, on average, slightly more different from one another than are individuals from the same population". More recently, elaborate empirical and theoretical analysis has highlighted how the relation between such differences crucially depends on the number of polymorphisms sequenced and the some measure of closeness of source populations. Expanding the scope to include the phenotypic aspect, Witherspoon et al. have recently speculated that a hypothetical trait, primarily determined by some identified set of additive loci with known worldwide distributions, could be analyzed using simple measures of genetic distances, since the allele sharing "genetic distance… is equivalent to a phenotypic distance". In my talk, I will trace the source of some of the confusion and suggest new perspectives for conceptualizing genetic distances. I will also show how an inferential leap from genetic to phenotypic distances is hardly straightforward, and that claims of equivalence between such distances should be handled with much care.

CONTRIBUTED PAPERS / C3.2 PHILOSOPHY OF THE LIFE SCIENCES

Fitness and Variance

Weslake Brad
Philosophy, NYU Shanghai, Shanghai, CHINA

In this paper I argue that a consequence of natural selection in populations with variance in reproductive success is that the fitness of a type is not grounded in the fitnesses of individuals of that type. I then argue that this entails that some fitness-involving evolutionary explanations are neither wholly causal nor wholly noncausal. I begin by introducing the propensity interpretation of fitness, here defined as the conjunction of four distinct theses:

PROPENSITY: Fitness is a propensity.
UNIFORMITY: Fitness has a single measure.
OFFSPRING: Fitness is measured by expected offspring number.
PRIORITY: The fitness of a type is grounded in the fitnesses of individuals of that type.

Previous discussions of variance in reproductive success have not adequately distinguished these theses, with the result that the implications for PRIORITY have not generally been appreciated. A notable exception is Sober (2000), whose argument against the propensity interpretation I turn to next. I describe and respond to two objections that have been made to Sober's argument, and then generalise the argument in two ways. First, I argue that it is PRIORITY, and not the propensity interpretation as a whole, that is the target of the argument. Second, I argue that the fundamental source of the problem for PRIORITY is not population size, but rather correlation in reproductive success. Here I rely on a model described by Frank and Slatkin (1990). By presenting the Frank and Slatkin model, I explain both why correlation is fundamental and why PRIORITY is false. I conclude by arguing that the failure of PRIORITY entails that some fitness-involving evolutionary explanations are neither wholly causal nor wholly non-causal. This in turn suggests the possibility of a middle way between causal and statistical interpretations of natural selection.

On the relation between biological information and biological inheritance

Ferreira Ruiz María José
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The relation between biological inheritance and biological information is close but tricky and unclear, and has not been directly explored. Since the rise of molecular biology, genes have been thought of not only as heritable units, but also as informational units. Moreover, they were considered the only heritable and informational units. The traditional focus put almost exclusively on genetic inheritance, and the early introduction of the term 'information' to refer to genes, may have given the impression that both properties come in a package, as if every heritable unit were an informational one, and vice versa. This, however, may constitute a confusion about these two concepts. At present, we recognize other, non-genetical, inheritance systems, but this only redoubles the confusion. Usually, biologists do not offer a clear definition of either of the concepts. Additionally, they sometimes refer to non-genetical heritable units as informational units as well. Among philosophers, there is no consensus on whether non-genetical structures can be said to carry information. While some authors presuppose the property of heritability in their accounts of biological information without explicitly specifying what the relation between the two concepts is, others seek to extend the concept of information so as to cover a larger set of hereditable units. The heterogeneity of the positions on the matter raises some puzzling questions. My aim is to analyze the conceptual relation between inheritance and information, and to suggest that the confusion can be addressed in two complementary directions. A first issue takes form when analyzing the notion of information: is the notion of inheritance constitutive of the notion of information in biology? A second issue arises when looking at the notion of inheritance, in connection with the multiplicity of inheritance systems: are there any reasons to treat every heritable unit as an informational one?

C3.3 PHILOSOPHY OF THE LIFE SCIENCES

Thursday, August 6 • 17:00–19:00
Main Building, Room 7

Understanding via false models in biology

Dieguez Antonio
Department of Philosophy, University of Malaga, Malaga, SPAIN

In model-based sciences, like biology, models play an outstanding explanatory role. In recent times, some authors have shown how the notion of understanding could shed light on the analysis of explanation based on models. Three important questions have been central in the debate: (1) What is scientific understanding?; (2) is understanding factive, i.e., does understanding presuppose or imply truth?; and (3) can understanding be objective? I will outline the main answers to these questions and I will support my personal contribution to question number (2) and (3) by showing how some false models have been used in biology.

False models are frequently used as tools for providing scientific understanding. When this happens, they constitute what has been called "felicitous falsehoods". Taking into account the different ways they can pursue this goal, I think it is important to draw a line between contrastive models and representational models. Contrastive models (e.g. a three mating types model) are false models that allow us to understand a real system by showing why some situations are impossible or very improbable in normal circumstances. Representational models are models explicitly designed to represent after all a real target system. The other three types of false models I will present –adjustable models, template models, and non-denotative models– belong to this last class.

All of them involve falsehoods which are necessary to the explanation of the behavior of the target system and to the understanding of the nature of real-world phenomena. Therefore, understanding is not factive. It does not presuppose that the majority of the beliefs involved in the state of understanding must be true. Finally, I will argue that understanding is not irremediably subjective. Some reasonable contextual criteria can be chosen in order to tentatively assess when a feeling of understanding corresponds to a genuine understanding.

Discovering Mechanisms, Investigating Phenomena, and Experimental Discovery-A New Account of Experimental Practice

Yeh Hsiao-Fan
General Education Center, National Formosa University, New Taipei City, TAIWAN

Biology as a special science challenges the traditional view of philosophy of science in many aspects. Many philosophers have splendidly argued about theoretical reductionism for about half century. Lindley Darden and C. Kenneth Waters, in order to go beyond the old debate, independently pressed the argument close to biological practice and developed different perspectives. Darden (2000, 2002, 2006, 2013), as the most important leader of the new mechanistic philosophy, claims that detailed description of mechanism is the most adequate biological explanation and suggests a set of mechanism-centered strategies. Waters (2004, 2008a, 2008b) claims that the adequate explanation must be generated from the interweaving theoretical explanation and investigation of new phenomena by manipulation. One of them replaces traditional law-based model with mechanism-based one while another shift diagnostic focus from theory-centered aspect to phenomenon- centered one. But it is still insufficient for a comprehensive account about biological practice, especially about experiments.

Chen (2013) recently deliberates "experimental discovery", which indicates experimenters need to find out regular patterns behinds first-hand phenomena, and then make them to be data model and significant phenomena, finally turn into the materials that mechanisms need. The process has nothing to do with some given theory in the beginning. It's the goal of investigating phenomena. Eventually, we will see the new account, discovering mechanisms approach is the most adequate way for understanding biology, and investigating phenomena approach provides the motive power and material to search for mechanisms, and we also need experimental discovery to give a useful strategy for further discovery.

The aims of this paper are: (1) to suggest a new account of experimental practice in biology; (2) to take the pioneer research in Evo-Devo, C. H. Waddington's works (1942, 1953, 1956), as a case study to show the new account could really work.

C3.4 PHILOSOPHY OF THE LIFE SCIENCES

Friday, August 7 • 17:00–19:00
Main Building, Room 17

The natural origins of value

Saborido Cristian
Dpt. Logic, History and Philosophy of Science, UNED, Madrid, SPAIN
Gonzalez de Prado Javier
UNED, Madrid, SPAIN

When the behavior of organisms is characterized in terms of goals or purposes, one does not just describe how such behavior actually is, but also evaluates it with respect to some standard. The notions of goal, purpose or success belong to the realm of evaluative normativity – goals and purposes set evaluative standards, according to which some performances/states count as successful and some as failed.

However, it is not obvious how biological goals arise. In virtue of what do biological systems acquire goals? There have been several attempts of defending the existence of observer-independent biological goals. Here, we consider two of these proposals: evolutionary approaches (Millikan, 1984; Neander, 1991), which argue that the relevant evaluative standards are fixed by natural selection, and organizational views (Christensen & Bickhard 2002, Weber & Varela, 2002, Di Paolo, 2005, Barandiaran & Egbert 2013), which hold that observer- independent evaluative standards arise from the process of self-production and self-maintenance of organisms.

We think that the claims at the heart of evolutionary and organizational accounts of biological goals have tended to be taken for granted without enough scrutiny. In this paper we analyze these two perspectives and propose an alternative account for the emergence of observer-independent biological evaluative standards. According to this account, the goals of biological systems are determined by the monitoring and regulating behavior of the very systems subject to such goals: systems can be said to be subject to goals because they treat performances as successful or failed regarding such goals. We further argue that normative evaluative standards can only arise in the presence of multiple evaluative perspectives. In this line, we claim that our approach to biological normativity is somehow related to philosophical approaches according to which genuine norms can only exist in social contexts (Wittgenstein 1953; Brandom 1994; McDowell 1998).

Did Machiavellian Thinking Shape the Reflective Mind?

Amitani Yuichi
Business Sciences and Regional Development, Tokyo University of Agriculture, Abashiri, JAPAN

In recent decades, considerable attention has been paid to the roles which social factors played in the evolution of the hominid mind. Prominent in such a movement is the Machiavellian hypothesis of human intelligence (e.g., Byrne and Whiten 1988).

According to this hypothesis, the need to cope with other members of the group in which one lives has been a selective pressure for highly developed cognitive abilities found in primates including human beings. Scholars like David Geary (2005) argue that this has been one of the most important factors throughout the evolution of our reflective mind.

I will examine this hypothesis by looking at two empirical studies. First, I will consider the case of the so-called "emotional intelligence." The test of emotional intelligence partly measures one's emotional management, the ability to cope with an emotionally and socially difficult situation. Some studies like Attridge 2006 found that there is only a modest correlation between the scores of the tests of emotional management and IQ tests, which suggests that the ability of emotional and social management may not have a strong connection to our advanced cognitive abilities.

Second, a number of neurological studies have attempted to identify the brain areas responsible for strategic thinking. When engaged in strategic thinking, one would use her "theory of mind," the core component of the Machiavellian intelligence, to predict what other people would do in response to her move. Researchers (like Hampton et al. 2008) showed that brain regions activated for strategic thinking are not the same as those activated for reflective thinking.

CONTRIBUTED PAPERS / C3.4 PHILOSOPHY OF THE LIFE SCIENCES

From these results, I will suggest that the Machiavellian thinking may have played a less prominent role in the evolution of the reflective mind than scholars like Geary have assumed.

Endless Forms in Endless Environments: Multi-Level Selection in Light of Darwin's Ecological Ideas

Tilmann Massey
Logic and Philosophy of Science, LMU Munich, Munich, GERMANY

In this paper I show, through formal analysis of Darwin's theory of natural selection, in which way the ability of selection theory (in its later formulations) to be applicable to different and across levels of biological organisation can be traced back to Darwin's original ideas. This is not trivial, as discussions about e.g. gene selection or evolutionary transitions emerged only long after Darwin, often involving concepts not yet developed in Darwin's times. Furthermore, whereas 20th century formulations of selection theory (population genetics, Price's equation etc.) usually involve some mathematics, Darwin's approach was couched mainly in qualitative/comparative terms rather than quantitative/metric ones. The only way to directly compare mathematised and non-mathematised versions of (allegedly) the same theory is to reformulate/reconstruct them in a single suitable framework. Within the set-theoretical framework chosen here, apart from individuals, traits and certain typifying and reproduction functions, "form" and "environment" are identified as important (but mostly overlooked) basic terms of Darwin's theory. The former term allows for assigning appearances and fitness values not only to individuals proper but also to sets of these, whereas the latter subsumes Darwin's descriptions of the interrelations between organisms and the respective conditions they are exposed to.

I show that some problems of multi-level selection can be tackled by splitting the fitness concept in line with Darwin's original ideas into a "performance"-function, referring to the performance of (sets of) individuals relative to an environment, and a "reproductive success"-function, which serves as means to empirically determine the values of the rather abstract "performance"-function.

I conclude that in neglecting the ecological component and focusing on reproductive success when defining fitness in abstract formulations of selection theory, some of the power of Darwin's ideas was lost both in the historical course of evolutionary biology itself as well as in philosophical treatment of these issues.

Two Kinds of Group Level Interactions in Trait Group Selection

Kokkonen Tomi
Philosophy, University of Helsinki, Helsingin yliopisto, FINLAND

The distinction between MLS1 and MLS2 models of trait group selection is about how the group affect the replication process: one attributes fitness for the group, one for the individuals partly on the basis of the group effect. There is a similar distinction to be made about the levels of the interactions of the behavioral traits that cause the differences. If group level selection occurs, it can be either collectivist group selection, where the group contribution for the fitness differences occurs similarly within the whole collective group of organisms and there are group level properties, or interactionist group selection, where the different interactions of individuals with others constitute the trait differences even within collectives of organisms. Here the trait differences are abstractions from the sets of individual behavioral dispositions. I will first argue that a behavioral trait and the underlying mechanism cannot be equated for evolutionary purposes. This matters because the mechanism gets selected but the behavior it produces is what it gets selected for. In the case of social behavior, they can get decoupled in a way that has consequences for the levels of selection. For example, in reciprocal altruism, the behavioral disposition for reciprocity gets selected because it is beneficial for an individual in a particular social context, but this is due to the interaction it creates between individuals participating in the interaction, i.e. the trait group. I will argue that there is an interpretation for the group selection model that is not based on there being two different levels regarding fitness but on there being group traits (the abstracted behavioral interactions) that get selected against alternative group traits (e.g. not interacting), and these traits are still dependent on making the individuals participating the interaction individually fitter than those who are not.

C3.5 PHILOSOPHY OF THE LIFE SCIENCES

Saturday, August 8 • 13:30–15:30
Main Building, Room 15

Lineages and Identity in Systematics: A Critique of de Queiroz's solution to the Species Problem

Alves Neto, Celso Antonio
Philosophy, Leibniz Universität Hannover, Hanover, GERMANY

Species are traditionally seen as evolving lineages (Hull, 1978). They are taken to be population-level lines of descent which speciate, change and go extinct across evolutionary time. For instance, de Queiroz (1997, 1999) claims that all species concept in the literature tacitly agree on the ontology of species, assuming that species are biological lineages. Insofar the conflict concerning how to delimit such lineages is unsolvable, there is no more no solution to the species problem other than say that species are lineages.

In this paper I criticize de Queiroz's solution to the species problem as a mean to reflect on lineages identity. My criticism assumes that the species problem is essentially about identity. First, I claim, the author promotes an interesting ontological division of labor: species are committed to one and the same ontological status, but they are individually committed to different identity criteria. De Queiroz detaches ontological status from identity. But that is not a way to solve the species problem in systematics, as I defend.

Species problem concerns how to count species and not how to characterize their ontological status. My hypothesis is that de Queiroz does not take the difference between the uses of "lineage" in systematics and evolutionary biology seriously enough. As an evolutionary concept, "lineage" can be applied loosely without presupposing a precise identity criterion. But if "lineage" is to be applied in systematics as a classificatory concept, this is not an option. There must be a clear identity criteria associated to it. Such a difference can be made clear by contrasting selection-based and phylogenetic explanations, as well as appealing to the role of pattern and processes in evolution and systematics. After exploring such concepts, it will be clear that de Queiroz ontological division of labor is a way to explain away the species problem.

An improved relational semantics of biological modalities

Huber Maximilian
Department of Philosophy, University of Geneva, Geneva, SWITZERLAND

Biological modalities are ubiquitous in all domains biological research and hence seem to play an important epistemic role. For example, in ecology, the competitive exclusion principle states that for a given habitat, the stable coexistence of two species occupying the same niche is biologcally impossible. However, there is no systematic theory of biological modalities. This is both surprising and problematic. It is surprising because modalities have been one of the most important topics in mathematical logic in the last decades; and it is problematic because the exact truth-conditions of claims involving biological modalities remain in the dark. The aim of this paper is to remedy this situation. In a first step, I will improve upon Dennett's (1995) relational semantics for biological possibility. These semantics are based on the Library of Mendel which is stipulated to contain 1. every logically possible genome, and 2. for each genome, a reader-constructor capable of producing the corresponding phenotype. Then, for some genome G1, x is is biologically possible if and only if x is an instance of a genome G2 or a feature of G2's phenotypic products, and G2 is accessible from G1. There are two main challenges: First, a salient interpretation of the accessibility relation must be provided since it is left undefined by Dennett. I will argue that the notion of an edit script from bioinformatics can be put to use. Second, it must be shown how the reader-constructor can be modeled and white-boxed. Here I will propose a solution in the spirit of dynamic modal logic. In a second step, I will discuss the adequacy of my improved relational semantics with respect to a range of case studies.

Darwin's solution to the species problem revisited: Can instrumentalism about species in taxonomy and realism about species in evolution be combined?

Reydon Thomas
Institute of Philosophy, Leibniz Universitaet Hannover, Hannover, GERMANY

The central question in the philosophical discussion on biological species concerns the reality of species. On the one hand the diversity of incompatible species concepts that yield crosscutting classifications makes a realist view of species difficult to uphold. On the other hand it seems that species must be real entities in nature – if they were not real, how could we make sense of research into speciation processes, species counts in ecology and biogeography, and work on species conservation? These contexts seem to require at least a moderately realist view of species. In this talk I will engage this tension between species realism and species antirealism. I will briefly review the current situation with respect to the species problem, survey the main ways out of the problem that have been proposed (and their deficits), and on the basis of this overview present an alternative solution to the issue. This alternative solution in part follows recent suggestions made by John Dupré, Marc Ereshefsky, David Baum, and others. Baum, for example, argued that species should be conceived of as instrumentally defined "ranked taxa" in taxonomy. Ereshefsky, too, takes an instrumental view of species as taxa in the hierarchical classificatory system of biology. While agreeing with the instrumentalist approach of these authors, I will nevertheless try to develop a modest form of realism about species by linking the (instrumentally defined) species level in taxonomy to the (realistically conceived) species level in evolutionary biology. The result is an instrumentalist view of species as taxa combined with a realist view of species as evolving entities. An advantage of this solution is an anchoring of the taxonomic species level to a class of real entities in nature. In addition, we will have more than merely pragmatic reasons to retain the notion of 'species' in biological science.

The 'Darwinian revolution' and the implications of different essentialism-related reasoning patterns

Talpsepp Edit
Philosophy, University of Tartu, Tartu, ESTONIA

It is a commonly held assumption that essentsialist thinking is inconsistent with evolutionary theory and should be abandoned as the result of adopting it. Essentialist thinking, according to which biological species have something like a physical essential property, shared by all and only the members of a species, is ascribed to pre-Darwinian taxonomists and assumed to be abandoned as the result of something like the 'Darwinian revolution'. The reasoning patterns that are assumed to be implied by essentialism involve the beliefs in: 1) the immutability of species; 2) the transformational view of evolution; 3) sharp boundaries of species taxa; 4) species monism; 5) taxonomic monism.

My claim is that not all the Darwinism-clashing reasoning patterns that are associated with essentialism are actually implied by essentialism, or imply each ohter. The philosophical independence of material essentialism and some Darwinism-clashing reasoning patterns allows us to hold these reasoning patterns even if we don't posit (material) essences to species taxa. Also, the fact that most of these reasoning patterns are philosophically independent of each other explains why they do not all have to be held or abandoned at once.

Discussing these matters, I will distinguish between particular and non-particular essentialism (ascribing a particular vs non-particular material essence to a species) that lead to somewhat different reasoning patterns. For instance, particular material essentialism leads to the assumption about the immutability of species, non- particular essentialism leads to the transformational view of evolution. Both particular and non-particular material essences lead to the assumption of sharp species boundaries and taxonomic monism (but not species monism). In my presentation I will characterize the implication relations between the Darwinism-clashing reasoning patterns and justify my claim that concerning the abandonment of biological essentialism, the 'Darwinian revolution' is not as abrupt as it's usually assumed to be.

C3.6 PHILOSOPHY OF THE LIFE SCIENCES

Tuesday, August 4 • 17:00–19:00
Main Building, Room 17

The proof-theoretic approach to evolutionary biology - can we work out a logic of evolution?

Andreea Esanu
Theoretical Philosophy and Logic, University of Bucharest, Bucharest, ROMANIA

In evolutionary biology, there has never been reached a consensus regarding the manner of presenting its sub- theories – be it the theory of natural selection or the genetics of populations. According to a widespread skeptical view, explanations of biological evolution cannot even be presented as proper scientific theories because of their lack of uncontroversial laws. This skepticism, however, is not shared by the logicians of science who claim that biological explanations can be molded into proper theories by means of logical reconstruction, i.e. by using the methods of formal logic. The logical properties of biological explanations might tell the important difference between empirical observations and laws in a way that would not require anything else but an adequate understanding of the biological logic itself. This approach is a traditional formal approach in the philosophy of science, and it draws from the works of Joseph Woodger's and Rudolf Carnap's on the axiomatization of natural science.

In the following, I will address three current developments of the formal approach to evolutionary biology: the hypothetico-deductive method, the semantic and the proof-theoretic method. Starting from here, I will point out that, in order to figure out the logical structure of biological explanations, the concept of deductive consequence (or deductive chain) from posits of some theory to sets of relevant facts has to play a key role. Then, I shall argue that a syntactic (proof-theoretic) approach to deductive consequence is a best option in formalizing biological explanations of evolution. Eventually, the proof-theoretic approach will do half justice to the skeptical view that there are no fully uncontroversial laws in evolutionary biology – in the sense that formalization via deductive chains will rest upon sets of specific assumptions.

C4

C4.1 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Tuesday, August 4 • 11:00–13:00
Main Building, Room 14

In virtue of what do personality traits explain?

Gurova Lilia
Cognitive Science and Psychology, New Bulgarian University, Sofia, BULGARIA

The attempts to construe personality trait explanations in psychology as causal explanations raise problems which cannot be easily overcome. Those who argue for the causal role of personality traits (e.g. Buss, McCrae, Costa) face the difficulty to explain in what sense a trait viewed as a tendency or a disposition 'causes' the particular events which instantiate the same tendency or disposition. On the other hand, the critics of personality trait explanations who doubt their explanatory status for the difficulties to construe traits as causes (e.g. Bandura, Cervone, Boag) cannot explain in virtue of what statements such as "Hugo did X because Hugo possesses a personality trait Y" increase our understanding of Hugo's doing X. In this paper I propose a non- causal construal of trait explanations which accounts for their explanatory role without need to introduce an ad- hoc and bizarre notion of causation. On this construal, any account of the explanandum which allows for making new inferences about the explained event (state, action, attitude etc.) increases our understanding of this event (state, action etc.) and on that reason we can count it explanatory. Thus, the statement "Hugo did X because Hugo possesses a personality trait Y" increases our understanding of Hugo's doing X and, respectively, we can count it explanatory, because this statement rules out certain alternative explanations for Hugo's action and allows to predict what might lead to a change of Hugo's behavior in similar situations. An important implication of the proposed inferentialist account of explanation is the obliteration of the distinction between explanation and description. On this account a re-description of the explanandum can be explanatory if it allows to draw additional inferences about the explained event (state, action etc.).

Integrating and unifying cognitive science using mechanisms

Milkowski Marcin
Section of Logic and Cognitive Science, Institute of Philosophy and Sociology PAS, Warszawa, POLAND

In this talk, I focus on mechanistic integration and unification in cognitive science. The mechanistic account of explanation is particularly sensitive to issues of inter-field research (Craver & Darden, 2013; Darden & Maull, 1977). There are at least three ways fields may become integrated mechanistically: by simple integration, when the models of mechanisms can be considered pieces of puzzle that fit together; by inter-level relationship, when another level of organization is added to make explanation more complete; and by inter-temporal integration (Craver & Darden, 2013, Chapter 10). In the case of simple integration, two fields may simply study cognition in a similar way but with a slightly different stress.

In this talk, I want to draw not only from the neo-mechanistic work but also from a proposal to understand inter- theoretical relationships in terms of constraints (Danks, 2014). The weakest kind of constraint is a truth- constraint: two bodies of knowledge satisfy a truth-constraint just in case they can be both true at the same time. Previously proposed mechanistic modes integration can be understood as constraining models of mechanisms.

To illustrate this proposal, I will draw on two examples: (1) research on hippocampus and memory, one of the classical illustrations of multi-level research (Craver, 2002); (2) a recent proposal to understand language as related to the mirror-neuron system (M. A. Arbib, 2005; M. Arbib, 2012). The latter proposal is highly controversial (Hickok, 2014), and it is useful to see whether the account of language in terms of the mirror- neuron system is an example of failed inter-level integration, as argued by Hickok. I will show that most arguments for and against the hypothesis that mirror neurons explain language can be spelled out in terms of failed constraining of mechanistic models of language-related mechanisms in the brain.

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Some Theoretical and Metatheoretical Issues in Computer Brain-inspired Projects: reflecting on Early Cybernetics looking to the present Neocybernetic projects

Montagnini Leone
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Present large projects like, e.g., the "Human Brain Project", could be considered as a renewal of the Early cybernetic work; that is, of those pieces of work that had been carried out by Wiener, von Neumann, Turing, Pitts, Rosenblueth, McCulloch etc., between the Forties and Sixties, working on the computer-brain parallel hypothesis. Early cyberneticists run into various difficulties finally resulting in abandoning the entire paradigm. These troubles mainly concerned:

1) The interdisciplinary collaboration. There were two fracture lines: between socio-human sciences

and hard sciences; between scientists (mathematicians, physicists and neurophysiologists) and engineers. Let's note that concerning this issue, very recently, a third additional, sharp, fracture line, between neurophysiologists and computer scientists arose.

2) The education of the staff working on this field. The Italian philosopher of science Vittorio Somenzi wrote, e.g., that the cybernetic program got to a halt because of the death of main characters, that were versatile geniuses endowed with a towering stature. If this is true, the situation is now much more complicated than in the past, in this time of very high specialization.

3) The extreme complexity of the brain. We must consider that the early cyberneticists used to consider both the "human brain" and the "computer based on the von Neumann architecture" as "computers", in the sense that both were for them Universal Turing Machines. However they never supposed that the human brain were a "computer based on the von Neumann architecture".

3) It was clear to the early cyberneticists that the brain is a machine elaborating information. But the nature of the notion of information was and is until now very uncertain. 4) The nature and role of the different codes acting in the brain.

C4.2 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Wednesday, August 5 • 11:00–13:00
Main Building, Room 4

Cognition and Rationality: Writing Straight with Crooked Lines?

Zilhão António
Philosophy, University of Lisbon, Lisboa, PORTUGAL

Typically, the debate concerning human rationality revolves around four standpoints: 1) 'Unbounded rationality', 2) 'Optimization under constraints', 3) 'Heuristics and biases', and 4) 'Ecological Rationality'. Proponents of 3) and 4) criticize the models developed by proponents of 1) and 2) for their cognitive unrealism. They contend that the complexity involved in their computational implementation is staggering; and that it makes them too costly and inefficient. Empirical results obtained in the cognitive psychology of human 'irrationality' support these contentions. However, many behavioural biologists contend that it makes sense to account for data gathered in animal behaviour research along the lines of models 1) and 2) above.

Stanovich (2013) tried to reconcile these conflicting results. He suggested that the strictures imposed by models 1) and 2) above are easier to follow when the cognitive architecture of a living creature is simpler rather than when it is more complex. Thus, humans fail to be rational not because their cognitive make up lacks the computational resources needed to implement normative optimization procedures but because its richness and complexity makes it difficult for them to conform to the latter.

I contend that the term 'rationality' is being used in this debate to cover too wide a semantic area. In fact, one needs to distinguish at least three meanings associated with it: procedural optimization, behavioural consistency and maximization of inclusive fitness. Although related, these notions are not congruent. In particular, procedural optimization is not a necessary condition for behavioural consistency; nor is maximization of inclusive fitness, in the absence of a complex form of procedural optimization, sufficient for behavioural consistency.

I conclude by claiming that the positions defining this debate are in fact much less clear than what is usually taken to be the case.

A Case for Eliminativism about Biases

Polonioli Andrea
Philosophy, University of Edinburgh, Edinburgh, UNITED KINGDOM

The concept of bias is one of the most frequently invoked in social and cognitive psychology: six decades of psychological research on human judgment and decision-making has produced an impressive list of "heuristics and biases" (Tversky and Kahneman, 1974), as well as a number of interpretations about their nature and cause (Hilbert 2012). On the other hand, such concept has recently attracted fierce criticisms: a number of scholars stress that the concept of bias should be abandoned tout court or simply avoid using it (Gigerenzer 2000, Genot and Parnamets MS; Kenrick 2013, Stevens 2008). In this paper, I defend an eliminativist approach with regard to the notion of bias. In particular, I put forth a heterogeneity argument, which purports to show that biases are not a natural kind because they are too heterogeneous. I take issue with the view that the concept of biases picks out homogenous phenomena by rejecting three claims that are commonly taken to support such characterization: a) biases are instances of poor and maladaptive cognition; b) biases are departures from normative standards coming from logic, probability theory, utility theory, and statistics; c) biases are the products of the same (intuitive) cognitive processes. As I argue here, these three claims are problematic. As it turns out, biases can be instances of adaptive cognition. Moreover, what characterizes important families of biases is not a violation of axiomatic rationality (I consider, for instance, cases of 'mental contamination' (Wilson and Brekke 1994)). In addition, several families of biases are defined only at a behavioural level, without specifying the underlying cognitive mechanisms, and can be the result of quite different cognitive processes. The upshot of my analysis is that, since the concept of bias is not a genuine natural kind, this should be eliminated from the vocabulary of scientific psychology.

Unrevisability as the mark of delusions

Soom Patrice
Philosophy, Heinrich-Heine Universität, Düsseldorf, GERMANY
Vosgerau Gottfried
Philosophy, Heinrich-Heine Universität, Düsseldorf, GERMANY

Delusions are key symptoms of many severe types of mental disorders. Even though the empirical research made considerable progress towards etiological and reductive accounts of delusions, an adequate theoretical definition of this concept is still to be offered. This contribution aims to use the theoretical tools of analytic philosophy of mind in order to provide a functional definition of the concept of 'Delusion', and to show how this definition may be used to set up a sub-type classification of delusions.

Starting from a critical evaluation of the DSM-IV definition of delusions, we shape a positive account of what delusions are from a functional point of view. According to this analysis, the criteria of i) falsehood, ii) inadequacy with the beliefs spread within the surrounding social community, iii) firm sustainment and iv) that delusions are about the external reality, are inadequate because they describe unnecessary conditions for delusionality. In fact, the content of delusions and its epistemic relations to the world and to the beliefs of others are inadequate to define delusions.

Delusions are essentially characterized by an asymmetrical inferential profile, which explains their immunity to revision in the absence of medication. Accordingly, delusions might impact on other beliefs of the patient, whereas they are not inferentially affected by the latters. This view is supported by arguments according to which delusions do impact on other beliefs, that normal beliefs are revisable and that assuming that delusions stand on a continuum with normal beliefs leads to intractable theoretical difficulties.

Building on from the above functional definition, we consider etiological and reductive accounts of delusions. According to the latter, there are two factors at play here: (a) tokening a problematic belief while (b) preventing rejection of this belief in spite of its inconsistency with evidence (Coltheart, Langdon, & McKay, 2011). In turn, this suggests that all delusions share a specific inferential profile and that the specific etiology of different delusions might contribute to individuation of (functional) sub-types of delusions. An empirically informed taxonomy of delusions might be established on that basis.

C4.3 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Thursday, August 6 • 11:00–13:00
Main Building, Room 4

What, when, and how do rational analysis models explain?

Pöyhönen Samuli
Social and Moral Philosophy, University of Helsinki, University of Helsinki, FINLAND

The rational analysis (RA) approach to cognitive modeling has become one of the prominent theoretical traditions in cognitive science, but disagreements concerning the explanatory value of the probabilistic models of cognition employed by RA theorists have given rise to a polarized debate. Proponents of RA claim that their models can provide novel understanding of many human cognitive capacities (e.g., memory, causal learning, conditional inference). However, the non-mechanistic nature of these models is in deep tension with a broad consensus in the philosophy of science, according to which genuine explanations must always describe causal structures. I assess the explanatory status of non-mechanistic RA models by disentangling different explanatory contributions that have been attributed to them. By relying on the contrastive-counterfactual theory of explanation, I assess the plausibility of three different types of explanatory contributions RA models could be seen to make. These contributions can be described as answering to three different kinds of counterfactual questions. First, there are constitutive what-ifs, which relate changes in components of the system and their organization to the properties of the macro-level explanandum (i.e. the cognitive capacity). Secondly, environment-behavior what-ifs track dependencies between changes in the environment structures and corresponding changes in the behavior of the agents. I argue, along with critics of RA, that there are several problems with both such explanatory claims. However, there is also a third way in which RA models could be said to lead to increased understanding of explananda: Under suitable conditions, mathematical analysis of the environment, together with knowledge of the cognitive constraints of the agents, can make possible the exploration of the 'logic of the situation'. RA models can lead to increased understanding by complementing mechanistic theories with precise models of environment tasks or affordances, i.e. of the possible space of action for cognitive agents.

The Predictive Coding Model of Dreaming

Fazelpour Sina
Philosophy, University of British Columbia, Vancouver, CANADA

The predictive coding framework promises the potential of a grand unifying theory in which any cognitive function can be understood on the basis of the brain's overarching function of hypothesis testing, carried out at various levels of the cortical hierarchy by a single kind of computational process with the shape of a Bayesian inferential operation (Clark 2013; Hohwy 2013). Within the hierarchically structured hypothesis space, the brain's generative model makes predictions whose probabilities are updated in proportion to how well they explain away the current sensory evidence. While the framework has gained immense popularity in dealing with cognitive functions constrained by sensory input, it is difficult to see how it can be extended to prominent cognitive phenomena, such as dreaming, that proceed in a largely decoupled fashion from environmental stimuli, given the crucial supervisory role played by sensory input within the framework.

Nonetheless, Friston and Hobson (2012; 2014a; 2014b) have recently proposed a predictive coding model of dreaming; dreaming has been assigned the functional role of optimizing the statistical efficiency of the brain's generative model by minimizing the model's redundancy and complexity. Furthermore, the function of complexity minimization is carried out by Bayesian inferential processes aimed at explaining unpredicted oculomotor input – the only sort of input available to the system during REM sleep.

My aim here is to critically examine three foundational issues facing the model, with a view towards developing constructive guidelines for future research. First, at the phenomenological level, what empirically testable implications does this functional role, assuming its correctness, have for the sort of content within a dream episode? Second, with regards to the processing level, are Bayesian inferential processes in general suited to the task of reducing a model's complexity? Third, is the Bayesian operation – in light of occulomotor input in particular – capable of delivering the assigned functional role?

The computer-scientists. About some models of creativity.

Chylinska Monika
Department of Theory of Knowledge, John Paul II Catholic University of Lublin, Lublin, POLAND

How is it possible for scientists and philosophers to think new surprising ideas and to come out with original artifacts? The central theme of my paper will be that these problems can be better understood with the help of some 'creative' computer programs.

To show the idea I am planning to describe some of the existing models of scientific creative processes as BACON, GLAUBER, STAHL, EURISKO (or some of the newer ones which are to appear in the closest future). These models are connected with all types of creativity mentioned by Margaret Boden (2004*); namely: with combination, exploration and transformation. I will indicate that some of them not only can produce novel combinations but – also – can make changes in their current basis so that new structures occur. These 'evolutionary programs' are used e.g. in designing new molecules in biochemical and pharmaceutical research.

To expect computer-scientists to correspond with the performance of some prominent and talented logicians as Kripke or Tarski is strongly unrealistic, but – whether or not computers can be creative in the same way as human beings – we have to admit that they can produce novel solutions. In my paper I will try to demonstrate that by analyzing how they do so we can be closer to understand how creativity takes place in full-blooded scientific minds.

*Boden M. (2004). The Creative Mind: Myths and mechanisms. Routledge.

A general set-theoretical model for the notion of "systemic change" in systemic-relational epistemology and psychology

Arpaia Salvatore Roberto
Human and social sciences, University of Bergamo, Bergamo, ITALY

In the classical systemic-relational approaches to epistemology, such as Bateson's (see [3]) or Piaget's (see [4]), in psychology there are of two different classes of learning processes: a "quantitative learning" (the cognitive system adquires information without changing the rules of reasoning) and a "qualitative" learning (an adaptation process which leads the system to a re-organization). Thus, a (systemic) process of change could be interpreted as a process that leads the cognitive organization of the subject to a different level of complexity by the creation of a hierarchy of abstract relations between concepts, or by the creation of new sets of rules of reasoning and behaving. We can therefore talk of logical levels of learning (process of "deuterolearning"), and the different levels of a learning process could be mathematically represented by means of the set-theoretical (well founded) hierarchy of logical types (where the process of learning is represented by a sequence of learning-stages, i.e by sequences of type-theoretically ordered sets, representing information/proposition and rules of reasoning/rules of inference)

In the present talk I will discuss the possibility of the definition of a very general set-theoretical framework as a formal model of qualitative change. I will show the applicability of this general model to pragmatics of communication and to philosophy of information. The model is based on two different logical theories:

• The first, from set theory, is connected to Bateson's learning theory, is based on Barwise's notion of partial model: by means of some simple examples I will show how, in learning processes, change from one cognitive level to another entails a violation of the type- theoretical well-foundedness of the model, that is, it entails the construction of some non-well-founded sets. This kind of sets (or sentences), called by Bateson double-binds, could be represented by paradoxical sentences (e.g. the liar sentence) (see [1] and [2]).

• The second, from proof theory and algebraic logic, is linked to Piaget's stages theory, is based on the idea that a psychological-change process (the development on new epistemic strategies), is a process starting from a cognitive state s0 and arriving to a cognitive state sn, possibly assuming intermediate cognitive states s1 , . . . , sn-1 : following and developing the researches contained in [5] and [6], I will propose a model of these processes based on the notion of non- monotonic consequence operator. ?

References . [1] Barwise, J. and Etchmendy, J., The Liar: an essay on truth and circularity, Oxford University Press, London-Oxford, 1987. . [2] Barwise, J. and Moss L., Vicious circles: on the mathematics of non-well- founded phenomena, CSLI Lectures Notes, 60, Stanford, 1993. . [3] Bateson G., Steps to an ecology of mind, Paladin Book, New York, 1972. . [4] Piaget, J. and Garcia, R., Toward a logic of meaning, Lawrence Erlbaum ?Associates, Hillsdale, 1991. . [5] Van Lambalgen, M. and Hamm, F., The Proper Treatment of Events, Black- well, London, 2004. . [6] Van Lambalgen, M. and Stenning, K., Human reasoning and Cognitive Science, MIT Press, Cambridge, 2008.

C4.4 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Saturday, August 8 • 13:30–15:30
Main Building, Room 16

Intertheoretic conflict as a mark of science – and why the neuroscience of consciousness is then no science

Fink Sascha Benjamin
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In all sciences there is intertheoretic conflict: If two theories describe the same section of the world, but make different predictions, they stand in conflict; there will be some state of the world that is compatible with one but incompatible with the other hypothesis. Einsteinian and Newtonian physics, for example, both described the behavior of light, but made different predictions how much rays of light will bend if they pass heavy stars; the aquatic-ape- and the monkey-fucks-pig-theory of human evolution both explain our unique hairlessness and fat-deposition, but both make different predictions about possible fossil records and their location. So in all cases of conflict, there is some decisive evidence that raises the credibility of one and simultaneously lowers the credibility of the competing hypothesis. In this talk, I suggest that this is an essential feature of scientific fields. It is also a common theme in philosophy of science: Popper and Kuhn allude to it, and one can derive it from the axioms of Bayesianism.

However, if intertheoretic conflict is a necessary feature of a scientific field, then the hyped search for neural correlates of consciousness (NCC) is decidedly not a scientific field: The widely accepted notion of a NCC provided by David Chalmers (2000) as that neural system with a state that is minimally sufficient for some conscious state prohibits intertheoretic conflict. I elucidate this with a comparison of two theories on consciousness, Viktor Lamme's Recursive-processing-theory (2005, 2006) and Giulio

Tononi's Integrated- information theory (2008, 2011). Both seem in competition, but are not given the letter of the NCC- operationalization.

My conclusion is then twofold: First, intertheoretic conflict is a plausible criterion to demarcate science from pseudoscience; second, given intertheoretic conflict as a necessary feature of scientific fields, then either NCC- research is unscientific or there is a failure in our operationalization of the field-defining concept ``NCC".

Cognitive phenomenology and the subtraction methodology

Hvorecky Juraj
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Arguments for cognitive phenomenology (CP) usually come in two different forms. The first relies upon the introspective process of subtraction, the second by metatheoretical considerations about the nature of the mind. Subtraction arguments ask subjects to abstract away from all somatic, motivational, perceptual or emotional components of their occurrent cognitive states and claim that there remains an irreducible proprietary phenomenal component for each such state. We argue that such a procedure cannot possibly establish a constitutive role of phenomenality in cognition. Our claim starts off with an analogy of subtraction arguments in the emotion research where proponents of widely disparate theories about the nature of emotions offer parallel arguments to advance their respective claims. Yet it is clearly puzzling that several contrary argumentative lines in the literature seem to be supported by introspective subtraction arguments, and results are often in a sharp contrast with those obtained by non-introspective means. This clearly indicates that subtraction strategy tells us nothing about the nature of the states on which it is executed and no claim to the component structure of these states can be based on this approach.

The argument is then extended to similar cases in the domain of CP not only by using a simple analogy, but also by employing the unity of mind thesis that proponents of CP also defend. We argue that what follows from this thesis is, among others, a claim about a methodological unity of mind. Hence, if subtraction fails in one mental domain, it is destined to fail in all others. Therefore, if CP is to be defended, arguments for it has to come from general considerations about the nature of the mind.

Synesthetic Experiences and the Philosophical Puzzles of Qualia

Marinova Mila
Cognitive Science and Psychology, New Bulgarian University, Varna, BULGARIA

Synesthesia is a rare and intriguing condition in which an otherwise normal experience of a person elicits a second modality. Throughout history synesthesia was considered a form of mental illness, an illusion or hallucination, caused by false perception or metaphorical thinking. As a result of the efforts of many researchers in the past two decades, it has been shown that synesthetic experiences are veridical, and the factors underlying those experiences are specific neurological activity and gene inheritance. The latest scientific findings in the field of the most remarkable phenomena of synesthesia (e.g. "seeing" color-graphemes or "tasting" music) has had a significant contribution to the current theories of consciousness in general. Considering this fact, I argue that synesthesia could be very informative for the philosophical debates about the nature of "qualia". I demonstrate how the results of recent fMRI and behavioral experiments of synesthesia can reshape the abovementioned problem of "subjective experiences" by offering new evidences. Based on these new findings I argue that "subjective experiences" can be considered as biologically based mechanisms which are important for our species` conscious and unconscious behavior. My conclusion has several implications, the most important of which are the following: 1) Subjective experience (qualia) should not address, nor try to provide answers to teleological questions; 2) The main criteria for ascribing the notion "subjective experience" to cognitive events are: attention, memory, and consistency.

The Neural Correlates of Conscious Content from a Mechanistic Standpoint

Vernazzani Alfredo
Institut für Philosophie, Universität Bonn, Bonn, GERMANY

The search for the neural correlates of consciousness (NCC) is divided into two research paradigms: one focusing on state consciousness, and the other one focused on the contents of consciousness. In this talk, I will only discuss the latter. According to some researchers, there would be a correspondence between the representational contents of consciousness and the contents represented in the neural system (Chalmers 2000). This thesis is known as the "Matching Content Doctrine" (MCD). There is however virtually no consensus about how we should understand the MCD, and some researchers reject it altogether (Metzinger 2004; Noë & Thompson 2004; Neisser 2012).

In this talk, I set out to shed light on the search for the content NCC and the MCD. In the first part of my talk I will clarify the notion of consciousness at stake. I introduce the distinction between representational and phenomenal properties, and show that the search for content NCC is only interested in the representational character of experience. Then, I will show that Chalmers's definition of content NCC is somewhat misleading because it seems to suggest a matching between two contents from two distinct representational systems: a conscious and a neural one.

In the second part of the talk, I put forward a different framework for discussing the content NCC. The representational contents of consciousness should be understood as functions of underlying neural mechanisms. Crucially, such mechanisms are also individuated thanks to the co-occurrence of neural activity and a corresponding conscious representational content. I redefine the MCD accordingly: it is the co- occurrence of some neural process with a conscious representational content. This co-occurrence might be elemental (injection, bijection) or structural (monomorphism, isomorphism). Finally, I briefly dwell on some implications of my perspective for further research.

C4.5 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Saturday, August 8 • 10:00–12:00
Main Building, Room 14

Motleys, Capacities, and the Mark of the Cognitive

Arnau Eric
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It is a widespread assumption on the debate about Extended Cognition that some of the challenges it faces ought to be settled by appealing to a mark of the cognitive (Rowlands 2009, Wheeler 2011, Adams and Aizawa 2008). The parity considerations used to foil the idea of Extended Cognition lead to well known quarrels about the adequate measure of functional grain at which differences and similarities between biological en external processes are relevant. If we set the criterion too strict, we endorse the biochauvinistic prejudices that Extended Cognition intends to dispel. If we set the criterion too wide, we face the threat of an absurd cognitive bloat. These problems would seem to vanish if we could provide a substantive mark of the cognitive. Such an account would demarcate the realm of the cognitive. If processes involving the manipulation of extraorganismic resources satisfied such a mark, there would be nothing left to quarrel.

In the first part of the paper, I argue that we shouldn't hope for a neutral mark of the cognitive that can settle the debate, as it would lead us to a question begging stalemate. But Extended Cognition doesn't really need a Mark of the Cognitive. Dropping that requirement would seem to render Extended Cognition vulnerable to an objection raised by Ruppert. He argues that the heterogeneous motley of elements, structures and processes that Extended Cognition embraces delivers a cluttered "unscientific" kind that would make the cognitive science lose its grip on the intended explanatory target (Rupert 2004, Adams and Aizawa 2008). In the second part of the paper, I consider this objection and argue that it rests on ungrounded assumptions about scientific explanations. It does pose a reasonable challenge, but it falls short on its attempt that Extended Cognition can't get off the ground.

The explanatory payoffs of the thesis of multiple realization in cognitive neuroscience

Serban Maria
Center for Philosophy of Science , University of Pittsburgh , Pittsburgh, USA

Assuming that we have an articulated stable higher-level theory and a theory pitched toward the lower-level of organization of the target system, the doctrine of multiple realization claims that there are one-to-many mappings from the unified (or homogeneous) higher-level properties to the heterogeneous lower-level properties of the system. Within philosophy, the multiple realization doctrine has been traditionally taken to license a pretty strong thesis about the autonomy of psychology from neurobiology and to set an antireductionist agenda for cognitive science in general (Putnam 1965; Fodor 1974). However, critics of multiple realization have contested the strong anti-reductionist consequences of the thesis. Their objections targeted both the conceptual arguments for multiple realization (Sober 1999) and the lack of empirical support for the doctrine within cognitive neuroscience (Bechtel and Mundale 1999).

In response, I argue that current scientific research provides ample support for the multiple realization thesis in both biology and cognitive neuroscience. Drawing a comparison between the degeneracy thesis and the multiple realization thesis allows us to refine some of the features and implications of adopting multiple realization as a viable research hypothesis in cognitive neuroscience (Figdor 2009).

In order to illustrate the methodological and explanatory payoffs of the multiple realization thesis I rely on research on the phenomenon of recovery of language functions after brain damage. This case study illustrates that the collaboration between different cognitive modeling paradigms (the lesion-deficit model, functional imaging studies of normal adult subjects and developmental models of brain function recovery) provides ample support for the multiple realization or degeneracy of higher-level cognitive functions. In this context, I show how the thesis of multiple realization promotes a pluralist methodology which generates hybrid (or mixed-level) explanatory strategies for explaining the properties and behaviors exhibited by complex biological systems at higher (and more abstract) levels of organization (Richardson 2009).

C4.6 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Thursday, August 6 • 14:30–16:30
Main Building, Auditorium IV

Can Non-Cognitive Values Have a Beneficial Role in the Assessment of Scientific Theories? A case Study of Evolutionary Psychology

Ivani Silvia
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Philosophers traditionally deny a role for non-cognitive values in the assessment of scientific theories. These non-cognitive values go beyond the range of internal scientific values and include moral, social, religious, aesthetic, economic, and political values. On this view, to exclude the influence of non-cognitive values on the appraisal of theories makes it possible to produce objective knowledge. My aim is to show that some non- cognitive values can have a legitimate and beneficial role in the assessment of scientific theories. I argue that non-cognitive values don't necessarily compromise the objectivity of a scientific theory. In order to develop my analysis, I examine the influence of feminist values on the assessment of the theories of evolutionary psychology. In particular, I analyze the influence of feminist values on the assessment of Sexual Strategies Theory. Intemann (2005) claims that non-cognitive values can play a legitimate role in the assessment of scientific theories if they are connected to the scientific aims of a research context. I suggest considering the aims of research contexts as cognitive values, such as empirical fit and internal coherence. I claim that non- cognitive values can have a useful role in the assessment of a theory if they are connected to the fulfillment of cognitive values. In other words, certain non-cognitive values may help to promote theories that possess relevant cognitive values. In my talk, I claim that feminist critique pinpoint the problematic aspects of Sexual Strategies Theory with the fulfillment of empirical fit. Therefore, I argue that feminist values help evolutionary psychologists to accept adequate theories and to reject the inappropriate ones. Reference: Intemann K. (2005), "Feminism, Underdetermination, and Values in Science", in Philosophy of Science, 72, 5, pp. 1001- 1012.

Methodological and philosophical problems of using thought experiments in moral psychology and behavioural sciences

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The usage of moral dilemmas and thought experiments has been proved useful in finding factors influencing our willingness for altruistic behaviour and partly determining our moral judgments however theoretical background still contains various problems. The aim of the paper is to discuss various issues linked with comparing and matching folk intuitions with well thought and reasoned philosophical standpoint. The methodological question preceding usage of thought experiments is whether human mind uses one consistent module for moral reasoning, i.e. utilitarian or deontological, or folk intuitions in moral dilemmas are closer to "moral toolbox" with more than one consistent module. The philosophical question of terminology in so-called "utilitarian" judgments in moral dilemmas like "trolley problem" and "ticking bomb dilemma" is the relation between "utilitarian" judgments and genuine utilitarian concern for the greater good which is currently quite unclear.

C4.7 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Thursday, August 6 • 17:00–19:00
Main Building, Room 16

Mental Imagery as a sign system?

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The query on the nature of mental imagery (MI) is one of the most controversial and yet important questions for cognitive science to solve. This issue was addressed by several theories – quasi-pictorial, descriptive and enactive (S. Kosslyn 1994; Z. Pylyshyn 2002, 2004; N.J.T. Thomas 2010, 2013). However, there is significant evidence that neither of these theories can give an exhaustive and coherent explanation of the cognitive role and nature of MI (e.g. M. E. Arterberry, C. Craver-Lemley & A. Reeves 2002; Bartolomeo 2008).

In my view, the most plausible and comprehensive explanation of mental imagery phenomenon can be given via signs. I believe that mental imagery can be interpreted as a sign system, which consists of various types of signs (indices, icons, symbols). Since there is a finite number of signs and their combinations, MI as a sign system is used by our Mind to economically encode the enormous flow of information from the outside world and further to solve different cognitive tasks. I find this role of MI as one of the most crucial in human cognition.

In my view, the approach to the explanation of the nature and cognitive role of MI in terms of signs is the most beneficial, since it not only explains in more detail the operation of mental imagery in human mind, but it also sheds some light on the cognitive role and function of MI. Thus, explanation of mental imagery phenomenon via signs deals more successfully with the divergent empirical data about MI and might suggest a new perspective on other issues in cognitive science, such as perception, learning mechanisms, memory, creativity phenomenon, decision-making etc.

A Naturalistic Theory of Perceptual Representations

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One of the marks of cognitive science is the widespread use of the notion of representation. Indeed, many have argued that an appeal to representations is required for the explanation of a wide range of phenomena, such as human behavior or off-line capacities. However, a standing difficulty in developing these ideas is that we currently lack a satisfactory theory of why certain states are representations and others are not. If such an account could be provided, theoretical debates on the nature and content of brain states would stand on a much firmer ground.

The goal of this paper is to provide the bare bones of such a theory. More precisely, I will argue that a particular theory of representation (SR-Teleosemantics) can explain why many states produced in the perceptual system are representations. Two striking virtues of this approach is that it has independent motivation and that it has already been used in other domains such as animal signaling or human communication. Accordingly, if successful, it will not only account for the representational nature of perceptual states, but it will also provide an explanatory unification of apparently distinct phenomena.

More precisely, SR-Teleosemantics defines representations by appealing to biological functions and sender-receiver systems. I will argue that both notions can be used to provide a theory of what makes perceptual states representational. Furthermore, I will show that there are good reasons for thinking it can also be used in the naturalization of other cognitive representations postulated by cognitive science. Yet, as I will show, completing this project turns out to be much more difficult than some teleosemanticists have thought.

Transitivity of visual sameness

Skrzypulec Blazej
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One of the important aspects of psychological considerations concerning vision regards the representations of objects' persistence. Investigations have focused on criterions of visual objects' sameness and the place of relevant mechanisms within the perceptual process. However, the formal properties of the visual sameness relation have not been sufficiently explicated. In the presentation I address, from empirical and philosophical perspective, one aspect of this problem: transitivity.

As we know from philosophical works, the 'sameness' can name various relations. The obvious question is whether visual sameness is the classical identity. The investigations concerning transitivity are highly relevant for this issue: being transitive is a necessary condition for being identity.

In the contemporary philosophy, the transitivity of sameness is tested by considering splitting-like cases, where an object A is continuous with two objects, B and C, existing at the subsequent moment. There are three solution in such a situation: (1) no sameness between A, B, and C, (2) sameness only between A and B or only between A and C, (3) sameness between A and both B and C. The occurrence of the third case shows that the sameness is not transitive, as transitivity would lead to paradoxical identification of different objects B and C.

I analyze results obtained by using Multiple Object Tracking and Object-Specific Preview Effect experimental paradigms, to consider whether they inform us about patterns of visual sameness in splitting-like cases. I argue that such situations do not break the sameness, but the occurrence of spatiotemporal continuity does not entail sameness (option (2)).

This result has twofold significance. First, it suggests that visual sameness is transitive and so is more similar to identity. Second, it shows that spatiotemporal continuity is not sufficient for the identity of visual objects and provokes the question concerning the proper characteristic of their identity criterions.

False Belief Attribution in Early Infancy and Its Neural Correlates

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In developmental psychology, the false belief task is used to measure children's ability to attribute beliefs, intentionality etc., to others. Because children typically pass this test around four years of age, most researchers agree that by 4 years old children possess a theory of mind (ToM). The debate in ToM research lies in the discrepancies of implicit vs. explicit task passing. Researchers have reported that infants are passing the false belief task implicitly, via eye gaze measurement, as early as 13 months, though they cannot explicitly, or verbally, pass it until 3 1/2 or 4 years of age. Multiple, and often contradictory, theories exist in an attempt to explain why there is this gap, or the illusion of a gap, between implicit and explicit passing, as demonstrated by the false belief task. Most of these accounts are psychological ones that use mental states, representation, belief and desire as explanatory forces. However, some psychologists like Ruffman and Perner (2005), Clemens and Perner (1994), and Sirios and Jackson (2007) have claimed that, in addition to these accounts, there is a rival theory that supposedly could incorporate brain regions, active/latent memory systems, and/or inhibitory mechanisms, etc. in explaining ToM. These psychologists seem to believe that psychological accounts of ToM are separate from, and incompatible with, neuroscientific ones. Following Marr's (1982) original idea that there can be levels of explanation in psychology, we looked into the neuroscientific accounts explaining the gap in ToM acquisition. This paper focuses on the implications, and ultimate invalidity, of a neural pattern account proposed to explain the implicit passing/explicit failing gap.

C4.8 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCES

Wednesday, August 5 • 17:00–18:30
Main Building, Room 10

Learning Natural Language Semantics Through Coordination

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In the formal modeling of natural language it is quite common to assume that syntax and semantics are predefined, and that they can be learned on the basis of social interactions. Even though this seems to be an appropriate idealization in the case of syntax, it is less so for the case of semantics. Humans learn new concepts all the time and constantly adjust those already in use. There is no given, prescribed semantics, even for a coherent population of language users. However, successful communication requires that semantics is sufficiently common. We present a plausible iterative mechanism for learning natural language semantics through coordination amongst communicating language users. We identify meanings of expressions with algorithms for recognizing truth values of sentences built up from these expressions. Language users test their algorithms on examples (finite models), i.e., situations they encounter and describe in everyday language. We know this phenomenon from our experience - algorithms (meanings) are rarely compared directly; we confront them extensionally, by observing the outputs for different inputs. In fact, we may have non-equivalent algorithms that equally well conform to examples seen so far. The subtle difference between quantifiers "half" and "every other" illustrates such cases. Effective communication requires that language users evaluate natural language sentences in

accordance with other interlocutors. Using the coordination mechanism, they guess new semantics that would make them more likely to communicate effectively. We extend the mechanism by ascribing authority to language users so that guessing new semantics is directly affected by the authority parameter. Another extension we study is related to spatial separation. It influences frequency of communication and thus may have severe impact on differentiation of language.

Analogical Thinking in Formal Semantics

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In the last forty years or so, formal semantics has become one of the leading areas of research in modern linguistics. It is widely acknowledged that an adequate formal-semantic theory must account for the intuitions of competent speakers about the truth-conditions of sentences uttered in context. It is also acknowledged that formal-semantic theories must be informed by developments in the study of syntax. But some methodological aspects of theory-building in formal semantics have not been studied in depth. In this paper I will focus my attention on a methodological tool that has influenced the work of formal semanticists since the early seventies: the use of analogical arguments.

Barbara Partee (1973) famously argued for a variable-based account of tense –and against a Priorean operator-based account– by pointing out that there are certain structural analogies between the linguisitc behavior of pronouns and the linguistic behavior of tenses. Partee's analogy argument led various linguists to look for theories that accounted for the semantics of pronouns and tenses in a uniform way. In the last two decades, some theorists have suggested that Partee's structural analogies extend to the realm of modality (see e.g. Stone 1997, Speas 2004, and Schaffer 2012). They have advocated specific views about the formal treatment of modals by arguing that modals exhibit the kind of pronominal behavior that tenses have.

In this paper I will analyze the analogy arguments mentioned in the previous paragraph from a methodological perspective. I will describe their structure, thereby making explicit certain assumptions that remained implicit in the original formulations of the arguments. By drawing on the recent literature on the distictiction between semantic content and assertoric content (see Ninan 2010, Rabern 2012, and Yalcin 2013), I will argue that the arguments at stake are less dialectically effective than it has been thought.

References: PARTEE, Barbara (1973) "Some Structural Analogies between Tenses and Pronouns in English", The Journal of Philosophy, Vol. 70, No. 18, pp. 601-609.NINAN, Dilip (2010) "Semantics and the Objects of Assertion", Linguistics and Philosophy, pp. 1-26.RABERN, Brian (2012) "Against the Identification of Assertoric Content with Compositional Value", Synthese, Vol. 189, Issue 1, pp. 75-96.SCHAFFER, Jonathan (2012) "Necessitarian Propositions", Synthese, Vol. 189, Issue 1, pp. 119-162.SPEAS, Margaret (2004) "Evidential Paradigms, World Variables, and Person Agreement Features", Rivista di Linguistica, Vol. 16, No. 1, pp. 253-280.STONE, Mathew (1997) "The Anaphoric Parallel between Modality and Tense", IRCS Technical Report Series, IRCS-97-06. YALCIN, Seth (2013) "Semantics and Metasemantics in the Context of Generative Grammar". In Metasemantics: New Essays on the Foundations of Meaning, A. Burgess and B. Sherman (Eds.). Oxford: Oxford University Press.

C4.9 PHILOSOPHY OF THE COGNITIVE AND BEHAVIOURAL SCIENCE

Wednesday, August 5 • 17:00–18:30
Main Building, Room 17

Cognitive neuroscience as a research tradition and a social practice: the case of episodic memory

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Because of the central role of the notion of mechanism (Craver, 2007, Bechtel, 2007), philosophy of neuroscience has recently been directed mainly towards an analysis of neuroscientific explanations -an analysis of their style, purpose and requirements. But how should we conceive the theoretical landscape shaped in such a field by recurring issues, conflicting results, different experimental techniques, and diverging theories? Two key concepts could be useful here. One is the concept of research tradition suggested by Laudan (Laudan, 1977): it would be legitimate to think cognitive neuroscience as a research tradition, because in such a field, we can identify general assumptions about what the entities and processes are, about the appropriate methods of investigation, and which requirements theories must meet. The alternative concept is the concept of social practice as presented by MacIntyre (MacIntyre, 1981). A practice is a socially established cooperative human activity where standards of excellence play a key role and where individuals have to develop specific qualities (or virtues) to reach the goals prescribed by such a practice. If the model of research traditions is useful to make sense of historical continuity, taking the social practice model seriously obliges us, in particular, to make explicit the kind of epistemic virtues that have to be developed to make valuable contributions to cognitive neuroscience. Taking as an example recent, groundbreaking work on neural mechanisms related to episodic memory and its relation to the simulation of one's future (Szpunar and al., 2007; Schacter and Addis, 2007), we would like to emphasize the role of ingenuity, receptivity and inventiveness as key virtues in neurocognitive research understood as a social practice.

Inductive Inferences in Cognitive Neuroscience

Kiikeri Mika
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Discovering the relationship between psychological functions and their realization at the brain -level is the central problem for cognitive neuroscience. The role of neuroimagining data in this task has been critically evaluated. It has become clear that certain assumptions have to prevail before neuroimagining evidence could be used to test cognitive models. Most of all, we have to assume a systematic but highly localized and at many occasions only many-to-one mapping between cognitive processes and anatomically specified brain regions (Henson 2005).

Many-to-one mappings raise a serious problem for reverse inference (i.e. inference from brain activation to cognitive function associated with an experimental task) because many or most brain regions are involved in multiple cognitive functions. This makes a Bayesian reconstruction of this inference form untenable (Poldrack 2006). Machery (2014) tries to amend the situation by showing that reverse inference could be profitably reconstructed as a likelihood inference in which the relative confirmation of two or more competing hypotheses is evaluated.

I'll evaluate some of the pros and cons of these reconstructions, and argue that the most interesting attempts to remedy the situation is not to apply abstract inference schemas but to improve factual knowledge of the architecture of cognitive functions, brain regions and their contexts. In recent years, the large-scale meta- analysis of fMRI data and other related techniques have made possible the developments of brain networks and systematic classifications of neural activities in brain regions. Although not in any way completed, I'll show how these developments could affect the inductive reach of reverse inferences. At the same time, we have to pay attention to the limitations of these methods: even meta-analysis could not help if the basic tools are limited and biased. Moreover, the localization of cognitive functions do not guarantee their explanation.

Cognitive Neuroscience and the Mechanist Thesis

Steenbergen Gordon
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Cognitive neuroscience is an interdisciplinary enterprise aimed at explaining cognition and cognitive behavior. It appears to be succeeding. What accounts for its apparent explanatory success? One prominent philosophical thesis is that cognitive neuroscience explains by discovering and describing mechanisms. In this essay, I identify and critically assess the theoretical commitments of one important interpretation of this thesis. According to this interpretation, the mechanist thesis is defensible on both descriptive and normative grounds: cognitive neuroscience is in the business of describing mechanisms; and mechanistic descriptions, insofar as they describe the network of causal dependencies that produce a cognitive phenomenon, are paradigm examples of good explanations. Indeed, on one particularly strong version of this view, mechanistic descriptions are necessary for explaining cognitive phenomena. However, I argue that arguments in defense of these commitments fall short of their descriptive and normative aims. In particular, the explanatory variety that is characteristic of the discipline poses a significant challenge to this interpretation of the mechanist thesis. Furthermore, an objection to the necessity of mechanistic descriptions for explaining cognitive phenomena suggests an alternative role for the discovery of mechanisms, namely, as a means of marshaling evidence for a variety of explanatory models.

C5

C5.1 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Tuesday, August 4 • 11:00–13:00
Main Building, Room 16

What explains economics imperialism?

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'Economics imperialism' denotes the spread of rational choice modelling to political science and sociology, as well as the explicitly economic-style modelling of non-economic phenomena such as that pioneered by Gary Becker and others. What explains it?

I propose the following answer: it is because the core of economic theory, i.e. rational choice theory, is domain- general. In particular, the formalism of rational choice theory does not explicitly refer to economic phenomena at all. An 'agent' may maximize under 'constraints' its 'utility function' with regard to anything, be it military victory, social prestige or electoral gain, not just economic matters. Accordingly, rational choice theory is easily exportable to any domain that features agents making choices – which means, in addition to economics, most of the rest of social science, as well as many parts of biology and even political philosophy.

But the same is not true the other way round. Central theoretical approaches in sociology, for instance, such as functionalism or conflict theory, are specific to the sociological domain. Analogous remarks apply to political science and anthropology too. Accordingly, exporting their theories in the reverse direction – i.e. to rather than from economics – is much harder and indeed has not happened.

I relate this analysis to three other explanations of economics imperialism. I argue that two of these – the prestige earned by economic theory's (relative) mathematical sophistication, and the appeal of methodological individualism – are in fact respectively a consequence of and dependent on economic theory's domain- generality. A third rival explanation has been suggested by economists themselves: economics has had imperial success because, unlike other social sciences, it generates empirical hypotheses testable by standard statistical techniques, and because it focuses on economic efficiency (Samuelson, Lazear, Becker). I argue that this third explanation is implausible.

A Defense of Equilibrium Methods in Economics

Jhun Jennifer
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A common criticism (even from economists) is that economics is not useful - nor, even more surprisingly, does it even aim to be. The culprit is an over-reliance on and misuse of "idealization": too much formalization without justification has made economics a field that seems unconcerned with giving a true or accurate representation of the real world. Complaints about over-idealization are most often targeting equilibrium analysis. While the characterization of the equilibrium state varies from subfield to subfield, in all cases of equilibrium analysis there are ceteris paribus - ``all other things equal" - assumptions, either explicit or implicit.

It is, of course, unsurprising that what happens in the world fails to align with our theoretical calculations. To criticize economics simply on that basis is to react to an oversimplified picture of economics, and in fact of science in general. I argue that this critical view only results from a commitment to a narrow conception of what scientific theories should look like and function. Reflecting on the ceteris paribus literature, and clarifying the role of ceteris paribus, reveals that disputes over what statements count as genuine scientific laws (usually those of physics) and what statements don't miss the point of the ceteris paribus methodology entirely. Furthermore, a careful comparison of economics with a well-establish science like thermodynamics demonstrates the extent of such confusions over the role and appearance of scientific theory. Once cleared away, valuable analogies between physics and economics become more apparent, making it more obvious economic theorizing may be after all.

How and Why Models Are Not Experiments – Epistemological Trouble in Economic Science

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Abstract: In my report, I will perform an epistemological analysis of thought experiments. I will consider the historical background of this research tool, its specificity, distinctive features of its functioning either in the system of natural sciences and in the economic theory. I analyse the nature of the relationship between a material experimentation and a thought experiment and the status of results of each of these procedures to acquire new knowledge. I claim that thought experiments in the economic theory and in natural sciences are fundamentally different and that the isolated thought experiment is not a full value research tool for investigating the reality but a good means for mapping and structuring the subject area. See attached file for full text submission.

C5.2 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Wednesday, August 5 • 11:00–13:00
Main Building, Room 16

The future – and present – of work and its rules facing technological transformations

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Technological transformations have been leading to deep changes in the world of work. These changes concern organization and production modalities. Such changes are mostly intended to significantly transform the concept of work itself and the relationship between man and work. It is therefore interesting, in a sociological-juridical perspective, to evaluate how technological transformations put pre-existing social and normative concepts to the test. From a logical-juridical point of view, the efficacy of regulation itself and its material topicality are called into question. The focus will be put on the role of work as a central and value element in the social organization. This role risks slipping into deep crisis, in view of a progressive separation between the tension in several economic sectors to create profits and the necessity to keep good occupational levels: practically, economies of scale are currently facing an asymmetrical increase in reached production levels and employed workforce. It is therefore necessary to evaluate how complex phenomena, such as technological unemployment – according to its Keynesian definition, "unemployment due to our discovery of means of economizing the use of labor outrunning the pace at which we can find new uses for labor" –, new professional identities and new ways of work organization, impact the system of juridical and social regulation. A diachronic observation of production dynamics, the reformulation of entire industrial sectors, and paths through which the digital world has transformed the exchange of goods and services, will be correlated with the socio-normative context and with the role of work with respect to juridical ecosystems. The conclusive question, partly open, is whether technological transformations impose – more or less gradually, through the legislator intervention – active juridical transformations as well, or, conversely, determine a passive transformation already in operation.

To what extent economic explanations are distinctively mathematical?

Hardt Lukasz
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Some philosophers argue that many explanations in science are distinctively mathematical (e.g., Lange 2013).

They do their work quite similarly like symmetry principles do in explaining: by limiting the set of events that could emerge. Or, in Lange's terms, they explain by appealing to mathematical necessity. Also, they can do their job while not using laws of nature as well as they can explain without citing causes of explanandum. Thus it is worth checking whether distinctively mathematical explanations are present in special sciences, including economics. The goal of my paper is to check to what extent economic explanations are distinctively mathematical. In doing so I am to focus also on the problem of distinguishing distinctively mathematical explanations from non-causal explanations referring to some mathematical facts. Since economics is to a large extent a modelling science (Morgan 2012), I will check how distinctively mathematical explanations do their work in economic models. The rationale for focusing on models, abstract entities isolating some aspects of their targets, in investigating the role of distinctively mathematical explanations comes from the fact that what makes these explanations non-causal is that they "ignore (and requires that one ignores) various physical details about the system of interest and appeals to a particular abstract structure of the physical system" (Batterman 2010, 3). So, one may find similarities in modelling economic phenomena and explaining them using distinctively mathematical explanations. Such explanations provide us with understanding of economic phenomena if appealing to laws and causal structure of the world is impossible.

References: Batterman R. (2010), 'On the Explanatory Role of Mathematics in Empirical Science', British Journal for the Philosophy of Sciences, 61, 1-25. Lange M. (2013), 'What Makes a Scientific Explanation Distinctively Mathematical?', British Journal for the Philosophy of Sciences, 64, 485-511. Morgan M. (2012), The World in the Model, CUP, Cambridge.

Appreciation Problems of Neuroeconomics

Hoyningen-Huene Paul
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Neuroeconomics is a new sub-discipline of economics. Its subject matter is the neuronal foundations of economic behavior. Many standard economists are critical of neuroeconomics; they doubt, partly in principle, that neuroeconomics is capable of contributing to the progress of economics proper. I will try to reconstruct and make plausible the main arguments of standard economists against neuroeconomics, mainly in positive economics. One argument claims that neuroeconomics is necessarily irrelevant to standard economics because of conceptually diverging goals of these two disciplines. Another argument claims that neuroeconomics is irrelevant to standard economics for empirical reasons. Given these reservations of standard economists, I shall formulate five recommendations to neuroeconomists. First, neuroeconomists should realize that in standard microeconomics, predictions have a much higher status than causal explanations whereas in the neurosciences the reverse is true. Second, neuroeconomists should become clear whether they want to positively contribute to, or criticize and/or change, or simply don't care about standard economics. For these alternatives, different strategies are advisable. Third, if neuroeconomists want to positively contribute to standard economics, they should realize that their work may often be devaluated as merely heuristic if their results can be reproduced by methods of standard economics. In addition, neuroeconomics does often not contribute to standard or behavioral economics but rather exploits their results for neuroscientific purposes without any benefit for economics proper. Fourth, if neuroeconomists want to criticize and/or change standard economics, they should use the same strategies that behavioral economists successfully used in the preceding decades for the same purpose. Fifth, neuroeconomists who do not care about their influence upon standard economics can still gain high academic recognition. In summary, neuroeconomics can gain greater appreciation within standard economics only if it can produce novel predictions of interesting economic behavior.

Dealing with plurality in scientific practice: The case of International Political Economy

Van Bouwel Jeroen
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Scientific pluralism, a normative endorsement of the plurality or multiplicity of research approaches in science, has recently been advocated by philosophers (e.g., Chang, Longino, Mitchell, Waters and Wylie) as well as social scientists. Comparing these accounts of scientific pluralism, one will encounter quite some variation. First, we want to clarify the variety of philosophical versions of scientific pluralism by showing how they incarnate different models of democracy (e.g., aggregative, deliberative, participatory, agonistic or antagonistic) – stipulating the desired social-epistemic interaction among the plurality of research approaches in different ways. Second, we analyze the recent debate about the desired interaction among the plurality of research approaches, or 'schools', in the discipline of International Political Economy (IPE). This debate was triggered by a paper of Benjamin Cohen (2007) in which he presents a way of slicing up the field of IPE in different schools as well as a proposal for its future development. The many reactions this paper provoked provide us with a clear insight into how scientific pluralism is understood by social scientists and how to implement it (see, e.g., the collection of papers in Phillips and Weaver (2011) and the 20th anniversary issue of the Review of

International Political Economy (2013); also see Sil and Katzenstein's (2010) account of analytic eclecticism). Scrutinizing this debate will clarify what social scientists themselves consider to be the ideal interaction among the multiplicity of research approaches (schools, theories, models, …). Further, the confrontation with the different philosophical accounts of scientific pluralism discussed in the first part of the paper enables us to make the social scientists' accounts more explicit as well as evaluate and refine the strengths and weaknesses of the philosophical accounts – helping us to spell out more carefully how different research approaches interact in the most productive way possible.

C5.3 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Thursday, August 6 • 17:00–19:00
Main Building, Room 4

A Decision-Theoretic Approach to Norms and Values

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The thesis that norms and values could be modelled in a formal way as decisions is defended in the paper. On the basis of this specific theoretical interpretation, the logic of decisions could be developed as a general formal theory of rational human activity and as a methodology of social sciences.

The unity of theoretical and practical aspects of human activities and the mutual connection of all pragmatic discourses is expressed in the process of making decisions. Norms and values are considered as performatives: a difference is justified between an act of forcing an authoritative or evaluative will and their propositional expression. Norms are introduced by performative utterances of the type: "I state that A is obligatory (prohibited)", which expresses a decision of certain normative authority. The result of it is a division of all possible actions into three, mutually-disjoint sets: obligatory, forbidden and indifferent. Normation and decision-making are human mental acts and their content is articulated through norms and decisions. The result of an evaluation is a division of all things into three sets: good, bad and indifferent. The philosophical and logical analysis of norms and values as decisions is a methodological tool for formal unification of all pragmatic logical theories and relevant discourses.

This approach outlines a perspective of solving some important methodological problems of social sciences: how to define rationality of action and free choice. The rationality of action could be understood in a theory as a positive evaluation or acceptance of certain normative rules with which this action is consistent. The free choice is an action in accordance with certain rules, adopted by the subject. In this way the proposed new approach to norms and values becomes a key to rethinking the foundations of social sciences.

Reasons and "Ought"

Gambrell Anthony
Social and Moral Philosophy, University of Helsinki, Reykjavik, ICELAND

I dispute the view, held by, e.g., Mackie (1977) and Raz (1975), that "ought"-statements are logically equivalent to normative statements of the form "There is a reason for φ-ing," "X has a reason to φ," and such. In conflict situations, e.g., where simple (pro tanto) reasons conflict, reasons are weighed and balanced in order to determine the strongest (overriding) reasons for an action, belief, etc. Not so, however, in the case of conflicting "ought"- statements where we are confronted, rather, by an irresolvable dilemma. This is so because "ought," taken abstractly, denotes a conclusive reason or overall reason ("all things considered") in providing a reason or reasons for action, belief, etc., namely a reason or a set of reasons for ultimate action, belief, etc. Admittedly though, if I ought, conclusively or "all things considered," to act in a certain way or to believe a certain thing, I can thereby be said to have a reason (or reasons) so to act, believe, etc. Also granted, "There is a reason for φ-ing" denotes a conditional ought. Yet this does not amount to a logical equivalency. For, conversely, if I have a reason to act in a certain way or to believe a certain thing, there is no knowing whether I ought (ultimately) so to act, believe, etc. Furthermore (and this is key), "ought"-statements require more than meets a conclusive or overall reason; thus "ought" cannot be reduced to a "conclusive reason," "overall reason," or an "undefeated reason." In this regard, we examine, notably, the role of commands, where an "ought"-sentence does not necessarily presuppose a reason, save the command per se.

Klein's Geometry and Ethical Theories: Invariances in Equality Spaces

Pagliani Giulia
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This study aims to explore the suggestion made by Williard Quine to Amartya Sen about "the comparison between (1) the classificatory principle for the ethics of social arrangements based on the equalities that are preserved (when the factual relations are transformed) and (2) the classificatory principles used in Felix Klein's attempted synthesis of geometry (in his Erlanger Program) in terms of the properties of a space which are invariant with respect to a given group of transformations" (Sen 1992, Preface, p. x).

Following Klein's reasoning, we considered as invariant properties, the focal variable(s) for which each ethical theory requires an equal distribution among individuals in order to evaluate the society as "just" and, as groups of transformations, the social policies required to maintain the distribution of the focal variable invariant. In our analysis we considered only few authors representing some liberal theories (Hayek for classical liberalism; Nozick for right-libertarianism; Otsuka for left-libertarianism; Dworkin for equality of resources; Arneson, Cohen and Roemer for equality of opportunity; Rawls' justice as fairness and Sen's capability approach) and the related evaluation spaces (ie., spaces in which each theory judges society as just): Respect of negative freedom, Resources, Opportunities for welfare, Distribution of primary goods and Capabilities (Sen, 1992, 2008).

To this end we exploited the mathematical approach called Formal Concept Analysis (FCA) introduced by Wille (1982). It is a mathematization of the philosophical understanding of a concept and it makes it possible to visualize the inherent structures of data, and their implications and dependencies. By using this instrument we were able to identify a hierarchical structure among the ethical theories considered.

Definitory and strategic rules in ethics

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In his 1999 article "Is logic the key to all good reasoning?" Jaakko Hintikka draws an analogy between logic and ethics in order to expose a shortcoming that has occured both in the study of logic and ethics. Hintikka claims that logic has been taken over by a "defensive attitude" geared towards the avoidance of logical mistakes. A similar mistake, he claims, has also been committed in ethics, all too often conceived as the the study of moral mistakes. He uses a distinction between definitory and strategic rules to examine this shortcoming and its consequences in logic. He, however, does not examine the other side of his analogy that deals with the similar distinction as it arises in theories of ethics. In this paper we examine those ethics-related aspect of his analogy that have previously gone unnoticed. These aspects are: 1) the possibility of introducing and applying a novel distinction to ethics in order to distinguish two fundamentally different kinds of ethical rules, the definitory and the strategic rules; 2) the use of these rules to illustrate a fundamental shortcoming in the modern conception of normative ethics; 3) the possibility to separate two conceptions of ethics from each other based on the type of rules that they aim to formulate; and 4) the radically different and yet unexplored idea of treating ethical rules as strategic rules.

C5.4 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Thursday, August 6 • 14:30–16:30
Main Building, Room 4

Austrian methodological individualism: from Carl Menger to Friedrich Hayek

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In Social Sciences, the methodological individualism is commonly divided in different versions, among which stands out the so-called Austrian methodological individualism. Initially, the Austrian School of thought dates back to Menger to elaborate its individualistic conception. However, in Hayek, such conception, receiving new determinations, moves away from the atomism of Menger. If, on the one hand, early in his career, Hayek warns on the importance of microfoundations, on the other hand, he does not accept the reductionism proposed by the atomistic individualism of Menger. As consequence, Hayek comes to a non-reductionist and non- essentialist methodological individualism's conception. In this sense, this paper aims to rescue the key elements of the Austrian methodological individualism, placing it in the current critical debate on the role of individuals in the analysis and interpretation of social phenomena. To this end, we conduct an analysis of the major works of the Austrian School, especially the writings of Menger and Hayek, which gives us a better understanding of the Austrian methodological individualism and its conceptual changes over time.

Mises' and Rothbard's Defenses of Praxeology – A Critical Analysis

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In this paper I present a rational reconstruction of the epistemology and philosophy of science of Ludwig von Mises and Murray N. Rothbard, the two main representatives of the Neo-Austrian School of Economics. According to them, the methodology of the theoretical social sciences is praxeology, which allegedly provides an a priori true and absolutely certain theory of human action. I suggest that this view regarding the epistemological status of the theoretical social sciences results from aiming at solving the problem of induction. In order to explicate and identify Mises' and Rothbard's positions, Popper's analysis of epistemological positions as reformulated by Milford is applied. It is shown that Rothbard's position may be classified as Essentialist Intuitive Universalism and that Mises - perhaps unintentionally - defends Conventionalism. Based on anti-naturalism, methodological dualism and individualism, he rejects alternative epistemological positions as unsatisfactory. The proposed classification resolves a number of interpretational problems in Mises' writings, which otherwise remain open. This is in contrast both to the received view, which interprets Mises' position as Apriorism, and to Tokumaru, who takes the Fundamental Axiom of praxeology to be a methodological rule. Also, the view held by representatives as well as by critics of the Neo-Austrian School and according to which Rothbard and Mises share similar epistemological positions is rejected. Consequently, their defenses of praxeology differ with respect to the methodological and epistemological status of economic theory, and its import for policy decisions. In addition, I suggest a problem shift regarding future discussions of praxeology: Emphasis ought to be placed on the purported deduction of praxeological theorems and not on the epistemological status of the Fundamental Axiom. The use of modern symbolic logic may help to identify gaps and hidden assumptions in the chain of reasoning from the Fundamental Axiom to, for instance, Neo-Austrian business cycle theory.

Do we need a universalizing paradigm for rational decision-making?

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Winther Rasmus G.
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An implicit assumption about theories and models in science is that they should not be used outside their proper scope of empirical application. We may wonder how much excess of abstraction is admissible before a model or a theory collapses. Our case study is the universalization of expected utility theory (EUT). We say that a theory is universalized when the scientists using it consider it capable of encompassing all interesting phenomena, both within its proper scope of application and especially beyond it. In this case, every kind of decision between uncertain alternatives is deemed to follow the axioms of EUT if we should consider it rational. A number of philosophers of economics have been arguing that EUT has gone beyond its proper domain of application: it can only represent our choices under very restrictive empirical conditions that do not exhaust the domain of rational choices. Ross (2005) has defended that EUT is mainly a faithful description of insects' behaviour and only under certain conditions captures the full complexity of human decisions; Guala (2006) contends that the preferences captured by EUT are often dependent on the structure of particular games and cannot be generalized beyond these contexts (or when these contexts are analogically met in human experience); Hausman (2012) claims that EUT describes our decisions only to the extent that these are subject to rational appraisal –assuming that rationality is precisely captured by EUT.

With these contributions in sight, we may wonder why economists and decision theorists have universalized and narrowed EUT, making it a general paradigm for the analysis of risky choices: was this a purely methodological option or was it driven by non-methodological factors? A group of historians of the social sciences (Erickson et al. 2013) have recently claimed that the universalization and narrowing of EUT is the consequence of the Cold War: had the American military not promoted interdisciplinary research on decision- making under uncertainty, the study of rationality might have proceeded in a piecemeal fashion respecting established disciplinary boundaries, with potentially fruitful dialogue among disciplines.

We want to assess the universalization of EUT in terms of knowledge-production and epistemic success or failure, and in light of similar processes in other disciplines: e.g., selfish gene theory or genetic reductionism in evolutionary biology; general intelligence factor and IQ in psychology and psychometrics. Did EUT contribute positively to the study of rationality or did it rather reify a particular version of rational choice for non-epistemic reasons? From a pluralist and perspectivalist standpoint, we question whether research on rational decision- making should really stick to a single standard of rationality, and on which grounds one could or should justify an option for one.

Ontic structural realism and economics: the unwanted gift

Patel Raj
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Should economics 'close interdisciplinary doors' to psychological content? In response to this question, the voices defending the mainstream status quo are loud and clear. The anti-psychological mainstream attitude epitomized by what is sometimes called 'minimalist economics' still has its staunch defenders. For example, the minimalist attitude is exemplified explicitly by two prominent economists (Gul and Pesendorfer) when they emphatically claim that economics is not about flesh and blood human-beings (2005).

Philosopher/economist Don Ross has mounted a scholarly defence of the minimalist status quo by attempting to accommodate economic theory within a view in the philosophy of science called ontic structural realism (OSR) (Ross, 2008). OSR can thus be thought of as a response to the critics of GP and minimalist economics. The type of OSR that Don Ross subscribes to holds that the world is composed of fundamental structures and that relata and objects do not exist. This view is motivated by the history of physics and theory change as well as the putative metaphysical ambiguity of objects in quantum physics.

Ross's defence amounts to the gift of a much-needed scholarly defence of the minimalist status quo. Taking GP and Ross together, their argument puts forward the idea that the subject matter of economics should be restricted to revealed choice behaviour and choice disposition, that individuals in economic models are at best useful theoretical constructs, and that psychological data is inadmissible as economic evidence.

This paper argues that OSR does no favours for economic theory. OSR requires a hard-line behaviourism making ordinary causal explanation unavailable to economists and it erects an unnecessary distinction between properly economic and improperly economic explanations, where the latter is infected with psychological content. It restricts, by fiat, any theorizing about underlying mental states of agents, even when such theorizing is essential to good economic explanation.

C5.5 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Friday, August 7 • 14:30–16:30
Main Building, Room 16

Applying Confirmation Theory to the Case Against Neurolaw

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Neurolaw is the emerging research field and practice of applying neuroscientific knowledge to legal standards and proceedings. This new intersection of neuroscience and law has put up some serious claims, the most significant of which is the overall transformation of the legal system as we know it. The claim has met with strong opposition from scholars of law, such as Michael Pardo and Dennis Patterson, who argue that neurolaw (and neuroscience more generally) is conceptually wrong and thus perceive most of it as "nonsense". In response, Sarah Robins and Carl Craver have shown why we may dismiss Pardo and Patterson's arguments as irrelevant to the actual practice of neurolaw, and Neil Levy has claimed that neurolaw is in fact not conceptually confused. I propose a different approach to the problem, exposing a flaw in Pardo and Patterson's arguments by means of confirmation theory. A similar approach has been used by Christopher Clarke in vindication of neuroeconomy. My main point is that Pardo and Patterson use implicit hypothetico-deductivism in their attack on neurolaw, and that we have good reasons to doubt the employment of such a model. Hypothetico-deductivism faces great, even insurmountable problems of a theoretical nature. I then demonstrate how the alleged problems associated with neurolaw disappear if we use a less problematic Bayesian model of confirmation. I also explain why the proposed probabilistic model provides a better account for the way the legal system actually works. In conclusion I argue that if Pardo and Patterson were right, the law would require a greater amount of transformation in the future than it requires on account of present day neuroscience.

Scientific Criteria of Humanitarian Knowledge and Structure of Theory of Law

Nevvazhay Igor
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For the first time distinction between natural sciences and human sciences was fixed by Neo-Kantians (W. Windelband, H. Rickert, and W. Dilthey). Contemporary development of humanities is connected with creation of multitude of competing theories. However we don't have yet clear beliefs about models of creation of humanitarian theories, and about a structure and functions of humanitarian theoretical knowledge. Display of specific character of humanitarian theoretical knowledge is still the actual problem. In the process of solution of this task I use the assumption that a structure, functions and scientific criteria of knowledge are connected with each other. Such scientific criteria as subjectness, objectivity, truthness, groundness, verifiability and falsifiability work effectively in natural sciences. However, these criteria do not work concerning theories of human life, in particular, law theories. For search of new interpretations of traditional scientific standards I consider the theory of law by Hans Kelsen as an example for creation of theoretical knowledge in the area of law. I come to a conclusion that objectivity and truthness of humanitarian knowledge consist in compliance of knowledge to valid values which are conditions of reproduction of a person living according rules. That is humanitarian knowledge is not an image of "objective reality", but a way of institutionalization of a subject, who knows what has to be, what is forbidden, and what is permissible. New meanings of scientific standards in the field of humanitarian knowledge are connected with necessity to review beliefs about a structure of this kind of knowledge. Structures of mathematical and natural science knowledge are studied rather well. The classical model of knowledge as a system (Aristotle) is not suitable in the field of humanitarian knowledge. I try to define both basic structural elements of a theory of law and normative theoretical knowledge on the whole. For this purpose I discuss the idea of syntagma proposed by German philosopher Rudolf Eucken. The concept of syntagma allows to include in a structure of legal theory subject's values. In this context I analyze a concept of presumption which have fundamental meaning for creation of any theory of law. In the conclusion I analyze methodological principles of communicative concept of law (M. van Hoecke, W. Krawietz, A. Polyakov) and prove that this concept corresponds to scientific criteria more than classical normative theories of law.

Economy and the Comparative Method: Justifying Phylogenetic Inferences in Historical Linguistics

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In historical linguistics, the Comparative Method (CM) is an important tool for establishing hypotheses about the genetic relationships between languages. Specifically, the CM is used to reconstruct unattested characters of ancestral languages (e.g. phonemes, morphemes, or syntactic structures) from character data supplied by extant languages that are assumed to be descendants of the ancestral language. One "rule of thumb" linguists use to reconstruct ancestral characters is called economy, which adjudicates between the various possible reconstructions of the ancestral state by saying that the reconstructed form requiring the fewest independent changes is most likely to be correct (Campbell 2013). Though linguists acknowledge that making inferences that appeal to "economy" requires some basic methodological assumptions, I argue that additional assumptions must be made explicit in order to ensure that linguists' phylogenetic reconsstructions are sound. Linguists' use of economy in the CM is very similar to the way the principle of cladistic parsimony is used in evolutionary biology. As Sober (forthcoming) argues, whenever evolutionary biologists make inferential appeals to parsimony to justify conclusions that one reconstruction is more reasonable than another, they are using parsimony (which itself is not justified as a basis for inference) as a proxy for something else which is justified. The purpose of this paper is to use the similarity between economy and cladistic parsimony to investigate what further assumptions are necessary in order to justify historical linguists' inferential appeals to parsimony. I conclude that while maximum likelihood models are the most promising of the possible solutions, they still cannot always justify linguists' use of economy as a rule of thumb.

On the Assumptions Required for the Automated Discovery of Theoretical Entities

Kummerfeld Erich
Philosophy, Carnegie Mellon University, Pittsburgh, USA

"Does religious coping reduce depression?" Social scientists are often interested in answering questions like this one, and increasingly they rely on empirical data and computational models and methods to do so. This talk focuses on one major challenge they face: how can they be sure that the theoretical entities they postulate, e.g. "religious coping", are accurately captured in the data they collect? Typically, practitioners use their intuitions to design survey questions that align with their hypothesized theoretical entities. Answers to these questions are said to be "indicators" of the value of one or more theoretical entities. Reliance on practitioner intuition alone is unreliable, so automated methods are used instead to discover theoretical entities that "cause" sets of indicators. Such methods constitute potential counterexamples to Hempel's claim that computers cannot discover theoretical entities. Hempel's concern can be evaded by committing ourselves to assumptions about the theoretical entities and indicators that are quite strong, perhaps too strong: "so much has to be assumed that one might justly conclude that the limits of scientific usefulness have been reached if not exceeded" (Bartholomew, 1999). Recent work by Silva et al. (2003, 2006) and Spirtes (2013) has produced methods that make weaker assumptions, evading Bartholomew's specific concerns. However, one could still argue that even these methods require assumptions that are too strong for a rational scientist to commit to. I argue that there are domains in the social sciences where it is rational to make these assumptions, and therefore automated discovery of theoretical entities is feasible. I review a laundry list of assumptions made by various methods and evaluate their individual plausibility. That survey questions are designed, rather than found, plays a key role in my position on some critical assumptions.

C5.6 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Friday, August 7 • 17:00–19:00
Main Building, Room 16

Karl Popper on Science of Society: A Refutation of Historicism

Afisi Oseni
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When Karl Popper applied his understanding of science to politics, his agenda for the social sciences was to establish the idea of a science of society using the methodology entrenched in his critical rationalism. With critical rationalism in science, Popper emphasized falsification, conjecture and refutation, and in politics, he emphasized openness of society. Both applications of his philosophy are combined within Popper's criticisms of Marx's scientific materialist interpretation of history. Popper's background as a philosopher of science focuses his criticisms of pseudo-scientific theories of society. As a philosopher of science Popper perceived as suspect claims by many scholars in the social sciences, such as

Marx, who wrongfully assumed that they could predict and interpret social phenomena scientifically. Marxism, in particular, claimed to be a scientific theory of historical and social development. It also claimed for historical social science the same objective value as theoretical science. Popper regarded this pretension as the claims of pseudoscience. He criticised Marxism for incorporating a historicist method of prediction; a method believed to function with predictive power over the future course of human history. Popper maintained that the historicist method has exerted a profound and problematic influence on the rise of totalitarian regimes. In establishing a science of society, Popper's preoccupation was to reveal the essential danger in historicist ideology and to show the inadequacy in the historicist's method in the social sciences. In this paper, I argue that the refutation of the historicist doctrine of the social sciences which Popper attempted has validity. My argument is based on the premise that Popper sufficiently captured the flaws in the idea of historical prediction of social development with his distinction between immutable scientific laws and contingent social development trends. The failure of the historicist to distinguish this critical difference between the two domains weakens the historicist argument.

A New Problem of Demarcation: Extra-academic knowledge in academic research and the challenge of objectivity

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It is common today in many disciplines to integrate extra-academic knowledge with scientific or academic knowledge. Researchers use artistic knowledge, tacit knowledge, the knowledge of experts by experience, or indigenous knowledge in participatory, collaborative and transdisciplinary projects. Often the aim is to produce policy-relevant knowledge. Thus it is important that the results can be trusted. It is, however, not obvious how objectivity is ensured when research is partly based on knowledge that has been acquired through extra- academic means.

When extra-academic knowledge is used in scientific knowledge production, demarcation becomes important in a novel way, as the line between science and non-science can be found inside the research process. In the recent literature on demarcation, science is generally recognised as a non-unified type of activity, which makes the quest for a single demarcation criteron misguided. Nevertheless, demarcation is necessary in the new forms of research examined here.

An interactive notion of objectivity has recently been defended especially in social epistemology. It takes a research community as the unit whose objectivity is to be assessed: interactive objectivity occurs when a research community follows inclusive procedures that allow effective debates.

Instead of focusing on the extra-academic forms of knowledge that are used in research, I suggest examining the new research communities that are emerging when extra-academic knowledge is used in academic knowledge production. They typically include both academic and extra-academic members. The epistemic practices followed in extra-academic communities are not necessarily in accordance with the inclusive procedures needed for a research community to be objective. As long as a community stays entirely extra- academic, this is of no concern to a philosopher of science. However, in the kind of research projects examined here, it is necessary to ensure that extra-academic epistemic practices do not jeopardise the interactive objectivity of the research community.

On Isaiah Berlin's Methodological Dualism Between the Natural Sciences and the Humanities

Demontis Luca
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Isaiah Berlin is certainly most widely known for his reflections on political theory and history of ideas than for those concerning philosophy of science. Nevertheless, recent interpreters have shown that his epistemological assumptions deeply influenced other aspects of his work. This paper aims to clarify some implications of his methodological dualism.

We will proceed as follows: in the first part, we will explain why he defends the autonomy of the humanities in front of the natural sciences; in his opinion, a unified method able to include all sciences is nothing less than "one of the most grotesque claims ever made by human beings". His main critical target is the application to the social sciences of the deductive-nomological model, according to which the explanation of particular events must be based on covering laws as general as possible.

Secondly we will argue that, according to Berlin, this is due to a false analogy, leading us to systematically misunderstand our expectations from social sciences. Dazzled by the achievements of natural sciences, social scientists cultivate the illusion of extending to their disciplines something like the galileian model of experiment repeatable under uniform conditions, in order to reach their same degree of axiomatization, internal consistency, formal elegance and explanatory simplicity. In short, the sternness of Berlin's dualism has to be read as a "dam" against the scientific imperialism that hard sciences, by virtue of their undeniable successes, constantly tend to exercise over the humanities.

With this in mind, we will be able to approach the issue by focusing on Berlin's history of ideas. In this respect, his epistemological assumptions are deeply indebted to Vico's notion of "fantasia": the logical positivists' "quest for certainty" blamed by Berlin is akin to the criticism against the "certum" that Vico developed in answer to Enlightenment rationalism.

Utopia and Scientism: Neurath and Social Planning

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This paper presents some proposals for social science advanced by Vienna Circle member Otto Neurath. We shall focus on the idea that one of the tasks of social scientists is to formulate utopias, that is, ideals of social, political, and economic arrangements. Neurath took part in social projects which can be understood as production and application of utopias. Even some Vienna Circle projects were seen by Neurath in utopian form, as proposals for social improvement by means of implementing certain schemes. An example is the encyclopedia proposed by Neurath in the 1930s as a way to unite those who adopt the scientific world- conception, meaning the scientific attitude towards problems. The production of such an encyclopedia would bring scientific-minded people together, creating a network of discussion about science, and constituting a political force against obscurantism. The work, once published, would disseminate the idea that science can help solving life's issues, which is the core of the scientific world-conception. Neurath's concept of scientific utopias is close to some literary utopias, particularly those by H.G. Wells, an author read and admired by Neurath. Both Neurath's philosophy and

Wells's fiction sustain that science is the main source of tools for planning social transformation. Such an idea is strongly criticized in philosophy of science by Paul Feyerabend, and in literature by Aldous Huxley. Those authors claim that imprudent scientism is harmful to society. This paper intends to show that Neurath prevents this imprudence by taking a pluralist and fallibilist stance, considering that there are no perfect plans to be implemented, as expressed in his well known metaphor: we are like sailors who must rebuild their ship on the open sea, without ever being able to dismantle it in dry-dock and reconstruct it out of the best components.

C5.7 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Saturday, August 8 • 10:00–12:00
Main Building, Room 16

On the Relevance of Doing Ontology in the Philosophy of the Social Sciences

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There are two prominent views on the relevance of ontological reflections for (the philosophy of) the social sciences. The first view assumes that ontological reflections play a foundational role for the social sciences as they have decisive consequences for the choice of explanatory strategies. Behind this view stands the conviction that the ontology of the social sphere determines the kinds of explanations that are acceptable in the social sciences. The second opposed view considers ontological reflections as mostly irrelevant or fruitless for the (philosophy of the) social sciences. In this view, too much attention has already been given to ontological questions about the nature of the social. In the end however, these kinds of questions, supposedly, have a paralyzing effect on the debate as they result in unending battles about different metaphysical intuitions. Some authors, consequently, argue for the de-ontologization of the philosophy of the social sciences and make a case for an entirely pragmatic approach, which focuses on successful explanatory practices and different epistemic interests in the social sciences.

In this talk, I propose that both views regarding the relevance of ontological reflections are insufficient. Neither does the ontology of the social sphere determine explanatory strategies, nor are ontological questions irrelevant for the social sciences and social explanations. Rather, there are a number of different roles that ontological reasoning can play for the social sciences. In my talk, I shall discuss two such alternative roles:

(1) Certain types of social explanations have strong, but unclear or taken-for-granted, ontological presuppositions that can, and should, be made explicit by ontological reflections.

(2) The explication and critical analysis of different conceptions of 'the social' can illuminate deeper relationships between different schools of thought and may thereby contribute to a clarifying systematization of the fragmented social sciences.

Phenomenological Constructivism in the Social Sciences and Vyacheslav Stepin's Concept of Civilization Development

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The paper has been devoted to academician V. Stepin's conceptipn of the social philosophy of science as "reflection upon the terminal ("transcendental") foundations of culture". Terminologically, the deep roots of his subject in the wide cultural context presents itself in the use of such not yet wide-shared concepts' combination as "social philosophy of science", "social context of scientific discovery," "philosophical anthropology of science." [1].

First, I would like to demonstrate, that Stepin's concept of civilization development (elaborated within the framework of what he calls (post)non-classical rationality) is deeply grounded in Western European social and philosophical thought' traditions of the twentieth century. I mean social phenomenology as a theoretical synthesis of M. Weber's interpretive theory of social action with the "late" E. Husserl's phenomenology of the life-world (Lebenswelt). As analyzed from this point, the meaningful structure of the social world turns out to be the product of typified social meanings "sedimented" in the structures of civilizational life-worlds. Values and meanings, intersubjectivley shared by cultural community, displays active, directing impact of the typified human views and beliefs, archetypes of perception, basic structures of understanding in the life-world upon the social construction of reality. In terms of social phenomenology institutional relationships of social life are based upon sedimentation of intersubjective social meanings, which constitute the core of civilization, i.e its cultural universals and the life-worlds. Socio-phenomenological approach to social analysis reveals its relevance in the epoch of profound social transformations, in order to display new attractors ("bifurcation points") of further development. Second, I will be trying to argue, that V. Stepin's approach to social construction of reality appears philosophically more sophisticated. His conception of "the social construction of reality" works out some shortcomings of phenomenological constructivism in social sciences' methodology.

Notes [1] See. Stepin V.S. Theoretical knowledge. Moscow: Progress-Tradition, 2000.

Ontologies of the natural and human sciences

Caws Peter
Philosophy, George Washington U., Washington, DC, USA

Scholarship in the humanities, in contrast to the sciences, does not normally come under the purview of the philosophy of science. The basic criteria for a discipline to become scientific (object constancy among observers, a common vocabulary for reporting observations, and agreement about the formulation of theoretical claims) have been lacking, and the variety of methods - historical, comparative, critical, etc. - have meant that the field has lacked any basis of unity.

Mill's treatment of the "moral sciences" at the end of his System of Logic (1843) suggests that the way forward in the philosophy of the social sciences and humanities is to imitate the methods of the natural sciences. Because of the complexities and idiosyncrasies of human behavior and culture the best these fields can do is thought to be statistical or even anecdotal. This might be called the "weak view."

But in what I shall call the "strong view" the human sciences are distinguished from the natural sciences not by their methodology but by their ontology.

One source for this view is Dilthey's Einleitung in die Geisteswissenschaften (1883 - a rendering of M ill's "moral sciences"), where he remarks that "mental facts are the highest boundary of facts of nature, facts of nature constitute the lower conditions of mental life." In the language of phenomenology "mental facts" correspond to "intentional objects," and their domain constitutes what I call the "second ontology" of the human sciences. I distinguish between physical and intentional objects, with an intermediate class of what I call "physical objects with intentional overlay," and I show how the intentional evolves from the physical, yielding the whole realm of culture. Criteria analogous to the three mentioned above can be developed to give the study of the humanities the status of a genuine science.

Husserl's Idea of Rigorous Science and its Relevance for the Human and Social Sciences

Gelan Victor Eugen
Philosophy, Academia Romana Iasi, Iasi, ROMANIA

The main aim of this paper is to show that the idea of rigorous science as elaborated by Edmund Husserl brings a fundamental contribution to the understanding, clarification and development of the idea of science in general, and more specially, to the structuring of the scientific character itself for social and human sciences. In the first step of my approach I shall focus on drawing a general theoretical framework for discussion for the problem of methodology and epistemology of social and human sciences. I shall start here from the way in which Husserl tried to give a philosophical clarification of sciences and grounded them through transcendental phenomenology. Husserl's idea of rigorous science proposed a new understanding of the way science gets itself constituted in general and led to important developments which determined the reevaluation of scientific character of other sciences, and particularly, of social sciences. The rich program of grounding social sciences and rigorous reconfiguration of their scientific character developed by the Austrian phenomenologist and sociologist Alfred Schütz is just one major exemplification of Husserl's idea of rigorous science. In the second step of my research I shall show how the Husserlian idea of rigorous science influenced the scientific understanding and approach of social life. In this sense, I shall direct my analysis on the way Alfred Schütz understands and elaborates the idea of social relation in a phenomenological manner by the means of which he tries to account for the phenomenological constitution of the significance of social action and of the possibility of knowledge in social sciences. In fashioning his program, Schütz starts from the Husserlian phenomenological reduction and from the theory of constitution of significance for Husserl. But, both the theory of the constitution of significance as the idea of phenomenological reduction itself are made possible for Husserl exactly by his idea of rigorous science. Key words: rigorous science, social sciences, human sciences, methodology and epistemology of science, transcendental phenomenology, possibility of knowledge.

C5.8 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Wednesday, August 5 • 17:00–18:30
Main Building, Room 6

Rejection of conceptual scheme relativism: A defense of Donald Davidson

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A common argumentation concerning conflicts based on cultural differences is that the conflicting parties do not share one common conceptual scheme: Their conflict, it is claimed, is due to a form of semantic incommensurability arising out of different ways of conceptual organisation of the respective input, leading to insurmountable differences in meaning and, thus, intranslatability. Davidson (1974) argued against this form of conceptual relativism that relies on the idea of conceptual scheme and offers a theory of interpretation that precludes radical conceptual difference. Glock's criticism (2008) attacks Davidson's whole project as it is directed against his positive argumentation based on the principle of charity as well as his critique of conceptual scheme relativism. Glock provides three connected arguments that are supposed to show that Davidson's position is alltogether unconvincing and, additionally, why radically differing concetual schemes are possible. First, he argues that Davidson's general claim that translatability is a criterion of languagehood is wrong and presents counterexamples of conceptual scheme differences and intranslatable languages. Second, Glock gives reasons why the intralingual version of conceptual scheme (analytic-synthetic distinction) should be maintained. Third, Glock offers reasons, why the principle of charity is a too strong and implausible precondition on interpretation. I argue that Glock's criticism does not succeed as his arguments either fail to provide enough detail to support his claim or are missing the point. His first argument is dealing with a form of conceptual difference that is not meant by Davidson, supported by counterexamples clearly missing Davidson's point. Glock's second argument remains too vague and fails to support his claim in detail, while his attack on the principle of charity uses a very implausible reading of the principle. I defend Davidson's ideas against Glock's criticism and show why the latter fails to defy Davidson's rejection of conceptual scheme relativism.

The Meaning of Pejoratives: Dependent and Independent Semantics

Valtonen Pasi
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There are two major views concerning racial and ethnic pejoratives. One is non-truth-conditional view and the other is truth-conditional view. According to the first view, the badness of pejoratives is something non-truthconditional. According to the other view, there is something wrong with the semantics of pejoratives. In this talk, I will asses Timothy Williamson's non-truth-conditional view. His idea is that a pejorative has the same extension and the same intension as the neutral term. For example, a pejorative 'the Boche' is salva veritate substitutional with a neutral term, 'the German'. However, you can see the offence in the conventional implicature of 'the Boche'. It implies that all Germans are cruel.

That is not only offensive but also false. I will go on to present linguistic evidence and argue that Williamson's view cannot accommodate the evidence. The problem is the substitutability. It seems clear that xenophobes do not use pejoratives and neutral terms coextensionally.

The evidence suggests that while the extension of the neutral terms is fairly stable, the extension

of pejoratives varies greatly from speaker to speaker. The invited conclusion is that there should be independent semantics for pejoratives which at the same time shows what is wrong with pejoratives. My proposal is based Mark Sainsbury's and Michael Tye's Originalism. First, they suggest that concepts are distinguished on the basis of their origin, not on the basis of their content. Secondly, they distinguish thinker's reference from standard reference. On the basis of the latter claim Originalism can handle the presented linguistic evidence and on basis of the first claim claim, we see what is wrong with pejoratives. There is a cognitive mistake concerning the origin of pejoratives: No one is cruel because he is German.

Sense and reversed (retrograde) semiosis in the Humanities

Skripnik Konstantin
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It is perhaps trivial to say that the notion of sense plays the central role in any discourse about the Humanities, and the sense is really corner stone in the liberal studies. If one accept this assumption, it needs to formulate the certain procedures for generating and analyzing the sense.

One model of sense generating is modified process of semiosis, primary relation of which is relation between signified and signifier. Then this relation becomes a new signified, and calls for a new signifier. So, the process continues further and further. The sense which was the result of primary relation between signified and signifier is changed at the every stage of this process. Sense looks like an onion or cabbage-head. This model of sense-formation is in a very simplified version of Peirce's process of "unlimited semiosis". It is not too hard to illustrate this process in the various branches of the Humanities. The analysis of the sense may be represented as a process of reversed (retrograde) semiosis – when one is looking for adequate sense of the subject of the humanities studies she has to dismount layer-by-layer in this "sense onion".

It is well known that Peirce's "unlimited semiosis" is inseparably linked with his triadic model of a sign, so the offered model may be extended. At every stage of generation and, especially, analysis of the sense we have to take into account "personal" (an interpretant's point of view) and "temporal" aspects of this enterprise. It seems it is what exactly we do in the history of philosophy or in understanding of the different phenomena of the Humanities.

C5.9 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Wednesday, August 5 • 17:00–18:30
Main Building, Room 13

Memory, Reification and Methodology

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An important strand of the recent critical literature on the appeal to memory in historiography questions it on ontological grounds of methodology, and specifically on the grounds that it unwittingly takes for granted or somehow presupposes certain methodologically unwarranted reifications. Key among these are the reifications of the collectivities and group identities that are the agents of memory, as well as the reification of memory itself understood as a precise set of manifestations somehow providing a privileged epistemic access to an event or collectivity, such as museums and memorials. On the other hand, an emerging strand in the recent literature on memory seeks to overcome these objections by somehow blurring the bounds between different collectivities as well as between different sets of paradigmatic memory manifestations. In this presentation I will seek to question, on very general methodological grounds, both the motivations of the critics and of the writers forming this emerging strand. Both kinds of reactions are unmotivated, I will claim. The critics of the appeal to memory on account of supposedly inadequate reifications, I will argue, ultimately presuppose a "nihilistic" approach to concepts on which the vagueness and/or indeterminacy of theoretical notions disqualifies them for historiographical purposes; however, concept vagueness and indeterminacy are simply unavoidable, and objections formally analogous to those of these critics could be leveled against just any kind of concept use in

historiography. On the other hand, the emerging strand of defenders of memory is thus seen to be guilty of conceding just too much to the critics. By seeking to dereify the agents of memory and certain constructions of memory itself, they will in any case have to reify other agents and other constructions of memory. But, more importantly, I will argue that in doing so they will unavoidably miss important, intuitively true accounts and explanations of historical phenomena requiring appeals to concepts for traditional collectivities and sets of memorial manifestations.

Levels of explanation in social sciences. A conceptual analysis of incompatible uses of the Coleman diagram CANCELLED

Alban Bouvier
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A vexing issue in social science is the identification of the relevant levels of explanation and of the relationships between them. James Coleman's Foundations of Social Theory (1990) seemed to clarify the general problems of explanation in social science in very simple terms. Coleman expressed his view in a diagram, known as "the Coleman boat". However, the numerous actual and possible uses of this diagram in the social sciences display its ambiguities: ontological levels, epistemological levels, levels of institutional complexity, levels of structural complexity, levels of scales, etc.

The 'looping effect' and the specificity of the social sciences

Ouzilou Olivier
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Ian Hacking's concept of 'interactive kind' is supposed to capture certain specific properties of the classifications in the human and social sciences. More precisely, the 'looping effect' (LE), which characterize interactive kinds, refers to a specific kind of interaction between a category and people who are classified as belonging to this category: the first arc of the loop is one in which the individuals being categorized react to being categorized and act accordingly; this response on the part of the categorized individuals causes social scientists to revise and adjust their original categorization, prompting thereby the second arc of the loop. Moreover, the concept of LE is supposed to have an explanatory relevance: it refers to the mechanism underlying social phenomena, and therefore corresponds with a specific causal trajectory. It must enable us to make inferences about the social agents' behavior.

Nevertheless, why would LE peculiar to the social sciences? It is indeed possible to consider that our classificatory practices result in feedback that alters not only human kinds but also some natural kinds. Hacking's response to this objection is that feedback loops occur in a particular way: subjects must become aware of the way in which they are categorized. However, Hacking's notion of 'awareness' is ambiguous. Why would awareness be a necessary feature of the phenomenon of interactive kinds? I want to show that we face a dilemma. If we want to preserve its specificity, we must think that LE is reasons-based: the awareness of the categorization must not only play a causal but a normative role in the history of the behavior of individuals. Nevertheless, if we adopt this view, this criterion of demarcation between natural and social sciences loses its originality because it consists in applying the famous distinction between Erklären and Verstehen to the problem of categorization.

C5.10 PHILOSOPHY OF THE HUMANITIES AND THE SOCIAL SCIENCES

Saturday, August 8 • 10:00–12:00
Main Building, Room 15

The Diffusion of Scientific Theories: Network Topologies and the Role of the Translator

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Döhne Malte
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How are scientific theories developed and how do they spread across scientific communities? We address those two questions by applying network analysis to a case of theory development and diffusion. We conceptualize a scientific theory as an 'innovation' that is invented by one or more 'innovators', which is or is not adopted by other actors in a network and argue that a theory has to be conceptually translated before it can be taken up, in and across (preexisting) scientific communities. Our case study is the theory of games developed by John von Neumann and Oskar Morgenstern in 1944. Departing from the observation that the adoption of game theory has increased disproportionally only from the 1970s on, we trace its initial spread across economics, philosophy, and the behavioral and social sciences at large. By developing a measure for diffusion of scientific theories and apply it to a data set of more than 4000 publications, we construct a co- citation network of what we identify as seminal works that have contributed to the dissemination of game theory. We show that game theory was collaboratively developed and further modified between the 1940s and the 1960s by a small group of outstanding scholars from distinct disciplines that we identify as translators, before it spread to the social and behavioral sciences at large. We identify these translators using an innovative brokerage algorithm. The topology of this networks sheds light on how scientific theories become developed, adopted, and further modified within and across scientific communities. We thereby make a general case for the fruitfulness of network analysis in the philosophy of (social) science.

A Model-Based Approach to Shared Agency

Heinonen Matti
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This paper argues for a new kind of methodologically naturalistic approach to the meta-theoretical status of philosophical studies of shared agency as a form of model-construction. The account sheds new light on the relationship between conceptual analysis and empirical theorizing in the domain of shared agency. The account grants an important kind of autonomy to conceptual analysis as a form of modeling that draws on causal and normative roles that are implicit in our ordinary framework of agency. The account also ensures that philosophical studies of shared agency can (at least in principle) contribute to a substantive understanding of the social world by means of the formulation of suitable theoretical hypotheses (Giere 1988) that bridge the gap between the model and the real world. The importance of interdisciplinary research in formulating suitable theoretical hypotheses is emphasized. Ultimately, the feasibility of philosophical models of shared agency is adjudicated on the basis of their capacity to produce correct predictions and explanations of occurrences in the social world.

Raimo Tuomela's (2007; 2013) I-mode/we-mode account is discussed as an example of a philosophical account of shared agency that is amenable to a reconstruction in model-based terms. The degrees of idealization and abstraction, as well as the fictitious features of the account, are shown to provide a compelling case for a model-based interpretation of Tuomela's account. However, the theoretical status of an account is taken to depend in part on the attitudes of the scientist or philosopher towards her theoretical constructs (Giere 2001), and this leaves open the possibility of alternative meta-theoretical reconstructions of the I-mode/we- mode distinction. However, it is argued that the model-based approach provides at least two distinctive benefits on philosophical and scientific discourse over the nature of the I-mode/we-mode distinction. First, the model- based reconstruction makes it possible to coordinate philosophical models of shared agency with theoretical models in other disciplines, such as models of team reasoning in economics and game theory (e.g. Bacharach 1999). Second, the model-based reconstruction provides a feasible division of labor between philosophers and empirical scientists who conduct research on the cognitive mechanisms underlying the I-mode/we-mode distinction (e.g. Gallotti and Frith 2013).

Team reasoning, framing and Frege cases

Blomberg Olle
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Proponents of team reasoning argue that it matters how agents "frame" or conceive of their decision problems. Team reasoning is a mode of practical reasoning that agents engage in when they frame a coordination problem as being a problem for them all together It is practical reasoning in response to the question 'What should we do?' rather than the more familiar 'What should I do?'. The answer is an "action profile" that includes the actions or choices of all team members, which maximises the chances of achieving the team's goal. According to Pacherie (2011, 2013), several agents' intentions to their part of an action profile form a "shared intention" if these are the outcome of team reasoning. ('Shared intention' is a socio-psychological causal antecedent that makes a joint action intentionally joint.) I argue that Pacherie's account faces a dilemma. If Pacherie allows that agents frame the goal of the team in different ways (e.g. "that we catch the prey that rustle the leaves" versus "that we catch the prey that casts the shadow"), then the account fails to rule out cases where agents falsely believe that there is no single goal that each reasons is the best choice for all. Such cases are characterised by a form of mutual exploitation rather than by team agency. On the other hand, if Pacherie takes the framing of the goal to be fixed, then she fails to accommodate clear cases of intentional joint action where agents represent the single goal of the team using different sensory modalities (suppose I'm blind and you are deaf). I argue that Pacherie can avoid both horns of the dilemma by introducing an extra condition: each participant must believe that there is a single goal that each reasons is the best choice for all.

C6

C6.1 PHILOSOPHY OF THE APPLIED SCIENCES AND TECHNOLOGY

Friday, August 7 • 11:00–13:00
Main Building, Room 16

The necessary revision of a topic: the homo faber is not the only animal faber

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It is a commonsense that the human beings have the capability of creating tools, machines, or in general artifacts. The definitions proposed in philosophy of technology about artifacts always involve the idea of human beings as their creators. See for instance the definition posed by Hilpinen (Hilpinen

1993, 156–157): "An object is an artifact if and only if it has an author." The idea of an author implies always the notion of an intention, which determine the intended character of the object. Other kind of definitions take into account the functional character of artifacts: "what makes artefacts unique (...) is not just that they have functional essences, but that their functions are determined by the intentions of their producers." (Baker, 2006: 132) Again, functions are related to intentions. And the same can be said about the definition proposed by the members of the Delft group, and the dual nature of artifacts: technical artefacts can be said to have a dual nature: they are (i) designed physical structures, which realize (ii) functions, which refer to human intentionality. [...] In so far as technical artefacts are physical structures they fit into the physical conception of the world; in so far as they have intentionality related functions, they fit into the intentional conception. (Kroes & Meijers, 2006, p. 2). All the definitions presuppose that the human beings are the only animals able to create intentionally tools. Nevertheless the new advancements in ethology have showed that there are many other species able to create tools too. I would like to show the main differences and the main similitudes of human and (other) animals creations, trying to avoid the anthropocentric view but avoiding at the same time anthropomorphism. The extreme examples (anthill) and the hooks of the New Caledonian Crows need to be correctly classified.

Analysing Framing in Design Reasoning

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Capturing the specificity of design reasoning is de facto self-defeating by the existence of designers. There is descriptive work how designers reason and prescriptive methods how designers can improve reasoning. Yet, when analyses capture the state of the art, designers start thinking 'outside the box' and introduce new forms of design reasoning.

Relative to engineering design one new reasoning form is *framing* as introduced by Donald Schön. Through framing designers reformulate the problems of clients, an ability that is seen as specific to innovative design. Framing is moreover a success term: by framing designers not merely provide solutions to problems but also let clients understand their problems and identifying new opportunities.

Methodologically framing raises the question under what conditions a solution to a reformulated problem counts as a solution to the original problem. Two analyses of framing given in design research are silent about this question; in my presentation I give a third for finding conditions to success and failure of framing.

A design problem is analysed as consisting minimally of two elements: a current state of affairs S and a goal state of affairs G. Framing is modelled by two reasoning schemes: one in which the designer reformulates the goal G in the client's problem $<S,G>$; and a second in which the designer characterises the current state of affairs S in the problem as being of a specific *type* T of states of affairs. The second reasoning scheme leads to a framed problem $<S,G,F_T>$. It is argued that the frame F_T can be represented by *solution directions* to realising G from S that the designer makes available by characterising S as of being of type T. For both schemes conditions are given under which a solution to a reformulated problem is not a solution to the original problem.

Projective Simulation and the Taxonomy of Agency

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Lini Giacomo
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In this paper we focus on behaviourism and materialism as theory-driven approaches towards the classication of AI in particular and agency in general. We present them and we argue for the fact that none of them can provide a full blown account of agency and intelligence.

Our next step is to analyse the ps model, a form of utility-based agent recently developed in the field of embodied cognitive science. We describe its internal working structure as a stochastic network of so-called “clips” step-wise updated, and how this structure characterises its main features. We individuate in its capability to perform projections its main characteristic.

We show that none of the two theory-driven approaches to AI is able to account for this feature, and we suggest that projection is a functional link between behaviourism and materialism, according to the fact that for its full blown characterisation we must refer both to behaviouristic elements (the agent-environment interactions) and materialistic ones (internal processes which may not be manifest in terms of a change in the agent’s behaviour).

This analysis allows us to present a feature-driven (or reversed) taxonomy of the concept of agency: we sketch its main characteristics and we show that it allows a comparison of different agents, based on the individuated functional link of projection, which is richer than the purely behaviouristic and materialistic approaches. The reason for that lies in the fact that we have reversed our approach towards agency from a theory-driven stance to a process-driven one.

A semantics for technical norms and practical inferences

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Zwart Sjoerd
Delft University of Technology, Delft, NETHERLANDS, Maarten Franssen, Delft University of Technology, Delft, NETHERLANDS

We assume a systematic corpus of knowledge can be found in technology which we will refer to as ‘the science of engineering design’. An important, and still open question about the relationship between science and technology (or engineering) is, then: what is the form of the ‘knowledge bearers’ within this science of engineering design? Niiniluoto (1993) has proposed, following up on previous work by Von Wright (1963), that the basic constituents of design research are ‘technical norms’, claims of the form ‘If you want A, you ought to do B’. However, Niniiluoto and Von Wright have different intuitions concerning the epistemic status of technical norms: according to Niiniluoto they have a truth value, whereas Von Wright was doubtful. The aim of this paper is to clarify this issue, and correspondingly to investigate whether practical syllogisms, which are arguments having a conclusion of the form ‘you ought to do B’, can be valid and if so, what determines their validity. Building on Hughes et al. (2007) and Meyer (1988) we outline a possible world semantics for technical norms and practical syllogisms. The main thrust of our approach is the idea that the intuitions of von Wright and Niiniluoto need to be grounded on the possible world semantics of dynamic logic in which actions of agents change possible worlds. We propose to interpret the statement ‘X wants A’ as ‘X obliges herself to bring about A’. This interpretation enables us to use John Jules Meyer’s deontic dynamic epistemic logic to give a truth value to statements of the form ‘If you want A, you ought to do B’: if in our world achieving B is a necessary condition to bring about A, it is true, but if there are paths towards an A-world that do not involve achieving B, it is false.

C6.2 PHILOSOPHY OF THE APPLIED SCIENCES AND TECHNOLOGY

Thursday, August 6 • 14:30–16:30
Main Building, Room 7

Galilean technoscience

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Galileo Galilei was one of those who created this new science oriented to technical needs. He made the important step in the revision of the Aristotelian physics. But the Aristotelian conceptual structure remains not only in the Galilean technoscience, but also in the nanotechnoscience. The same conceptual structure was the basis of the ballistic as new engineering theory of Niccolo Tartaglia. Galileo created more than a model of experimental activity; he demonstrated how to develop scientific knowledge so that it could be used for technical purposes. This approach became possible because Galileo’s new science had its roots in technical practice and was oriented to it. In his new science, Galileo manipulated natural objects like the present-day engineer. However, Galileo’s new style of scientific-engineering and engineering-scientific thought and action manifested itself mainly in the sphere of thought rather than in practical activity. Galileo’s works paved the way for the formation of engineering thinking and activity in practice as well as theory. That is why his science was not only the embryo of the natural sciences but also engineering science and was really technoscience similar modern technoscience (e.g. nanotechnoscience). (RGNF project 13-03-00190).

Mode 2 of Knowledge Production and Mixed Techno-Scientific Roots of Computer Science

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Computer Science includes a spectrum of disciplines: from mostly engineering ones to pure discrete math through dozens of mixed disciplines. The continuous collaboration of these fields results in flow of innovations in contemporary Information Technology. Hence, Computer Science is mixture of both technology and science.

In "The new production of knowledge" [Gibbons'94] it was argued Computer Science was initially developed as Mode 2 of knowledge production. Mode 2 is transdisciplinary, accountable and reflexive knowledge produced in context of application. It opposes to Mode 1 monodisciplinary science pursuing universal truths. Mode 2 produces both science, technology and public good in one coherent framework.

My aim is to develop the account of Computer Science as Mode 2 by getting deeper into what exact events, principles and practices made Computer Science referred as Mode 2 of knowledge production.

This exploration helps clarifying the distinction between: 1) applied sciences and Mode 1-engineering disciplines on one hand; 2) present Mode 2 domains of knowledge production like Computer Science, Biotechnology, Nanosciences, and so on, on the other. The distinction marks the demand of new concepts in philosophy of science and technology to perceive the latter.

Confucianism and architectural technology in traditional Chinese society

Liu Shanshan
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In contrast with European architecture, which went through a tremendous change of stylistic trends, the evolution of traditional Chinese architecture followed a unique course in which there was only small and slow variation over thousands of years. Unsolved issues remained in the development process of traditional Chinese architectural technology, such as the lack of motivation to build high structures except for Buddhist temples and the delay of applying masonry structure in domestic architecture despite the already existing tradition of using it in tombs. In general we can observe a degeneration of rational structure design for instance the disappearance of triangular support in roof structure.

All those issues seem to be related with the famous Needham Puzzle. Or in my case to the question why given that the technologies were existing and already in use their wide application was discourage or they degenerated? I'm arguing that the reasons for that phenomenon are due to something more than historical contingency. My proposal is that the underlying factor which did not permit the evolution of architectural technology was due to a broad philosophical trend in traditional Chinese culture. The Confucian ideal of modesty and humbleness influenced the layout of cities and the design of buildings. In turn the preference for static systems over more dynamic mechanical system was the reason why the usage of triangular support was discouraged.

All this lead to a restriction of large-scale constructions and depressed the development of high level architectures, although the underlined technology was already available to architects and was in some cases more economically efficient. Finally I believe that this historical case study will contribute to the understanding the complex relation between philosophical values and technological development.

A Re-Examination of the Relationship Between Science and Technology

Chakrabarty Manjari
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This paper attempts to revive interest in the old and apparently out-dated problem concerning the relationship between theoretical science and technology for two main reasons. Firstly, it aims to show how philosophical understanding of the science-technology relationship has long been associated with two dangerously misleading prejudices. Secondly, it intends to shed light on the radical implications of Popper's distinctive vision of science - an enterprise of bold conjectures and blunt refutations - for some of the key debates in philosophy of technology.

In the history and philosophy of technology studies of the relationship between science and technology have been largely dominated by the technology-is-applied-science thesis and the objections to this thesis. Critical reviews of the existing literature show that different arguments have been advanced by historians and philosophers of technology to characterize technology as an autonomous body of knowledge, different from science. Some scholars, for example, have tried to contrast directly scientific and technological knowledge, while others have emphasized the tacit and prescriptive nature of technological knowledge.

In contrast to these current arguments advanced against the technology-is-applied-science thesis, this paper questions the credibility of the said thesis on the grounds that it has emerged from the ancient philosophical doctrine of induction which nurtured two misleading prejudices, namely, that scientific hypotheses are prompted directly by perceptual experience and that technology emerges out of science, and is based firmly on science. Drawing on some key features of Popper's Searchlight theory of knowledge I try to renounce the former prejudice in the first section of this paper. The second section of this paper aims to overthrow the latter prejudice on the basis of an analysis of Popper's critical rationalism that emphasizes a critical (but not a constructive) function of theoretical science in technology.

C6.3 PHILOSOPHY OF THE APPLIED SCIENCES AND TECHNOLOGY

Wednesday, August 5 • 17:00–18:30
Main Building, Room 15

Health claims: regulation and scientific controversy

Todt Oliver
Philosophy, University of the Balearic Islands, Palma, SPAIN
Luján José Luis
Philosophy, University of the Balearic Islands, Palma, SPAIN
Bengoetxea Juan Bautista
Philosophy, University of the Balearic Islands, Palma, SPAIN

This paper analyzes the debate about the use and limitations of different scientific methodologies, particularly human intervention studies, for data generation in health claim regulation, by identifying the underlying controversies about methodological choice. Regulation in the European Union imposes the need for a scientific substantiation of all health claims (claims about a relationship between consumption of certain food ingredients and desired health effects). Randomly controlled trials are the method that generally is considered to provide the highest quality of data for decision making in health claim regulation, because they allow for establishing cause-effect relationships (demanded in European regulatory practice for authorization of a claim). This very strict requirement has led to a debate about the advantages and limitations of this methodology in data generation for nutrition research and regulation. Our analysis identifies underlying controversies about the standards of proof, as well as the role of non cognitive values in methodological choice for regulatory decision making. The regulatory process aims at minimizing false positives in order to protect consumers from false claims, while the critics of the reliance on data from randomly controlled trials point to the necessity for relaxing the standards of proof and selecting other scientific methodologies on the basis of non cognitive values.

Measuring Risk by Subjective Indicators

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In his work on risk measurement by means of subjective indicators, Roger Cooke asks the following questions: “Does our understanding of risk keep pace with the risks we ourselves create?” (1991) Cooke’s motivation for using subjective indicators of risk is that we often lack objective, probabilistic or model-based indicators that are needed in order to assess the risk of a given system (for example, a nuclear power plant, a dam, a volcano). Risk is a moving target and some risk factors change together with lifestyle and the changing environment. However, the lack of “objective” indicators and mutability of the target system, are not the only reasons why we need subjective indicators when measuring risk. An additional reason is that the measurement of risk can at times be itself a source of newly-created risk. Thus mechanical and objective measures of risk, which are necessarily based on premises that are bound to change once the new risk has been created, are limited in their use in concrete applications.

CONTRIBUTED PAPERS / C6.3 PHILOSOPHY OF THE APPLIED SCIENCES AND TECHNOLOGY

Some examples will illustrate; let us consider the financial sector: In ‘Strategic Risk Taking: A Framework for Risk Management’ Aswath Damodaran writes “since investors in financial assets share in both upside and downside, the notion of risk primarily as a loss function (the insurance view) was replaced by a sense that risk could be a source of profit.” In finance, as well as in much of economics, risk is created by the act of measuring it, in the sense that it is necessary to measure risk in order to create economic opportunity. Some accounts take risk attitudes to be the outcome of adaptation (i.e. Ralph Hertwig, Mariam Thalos). As an adaptation we can only measure risk in relation to the ecological (and contingent) situation in which we find risk. But at least in some sectors of our society the measurement of risk is a reflective activity because it allows the creation of additional risk. In fact, from the point of view of a model with assumptions and ceteris paribus conditions, the measurement of risk by itself creates new risk by changing the initial conditions of the model. The observations made so far suggest that subjective indicators of risk are the only ones able to capture the adaptive and reflective activity of risk measurement, therefore remaining an essential source of knowledge on a par with statistical tools and models.

Philosophical notion of responsibility as a foundation for Value Sensitive Design and for Responsible Innovation

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The supporters of Value Sensitive Design (VSD), e.g. Batya Friedman, Peter Kahn, and some researchers in Europe who call for new, balanced attitude towards innovation, give a direct answer to at least some of the ethical problems associated with new technologies. Followers of VSD underline the fact – which I presuppose in my research – that the design of innovative products and processes should anticipate a certain set of values, and that it should happen already at the stage of conceptualization (Friedman 2004; Friedman, Kahn 2000; Friedman et al. 2008), i.e. much earlier than at the stage of implementation – what happens often due to the so called technology push (Von Schomberg 2013). As such VSD avoids the unintended consequences of innovations. I wish to examine the relevance of the VSD approach for the framework for Responsible Research and Innovation (RRI). The interrelations have already been noted in the literature (Hoven 2013, Correlje et al. (forthcoming)). I investigate the role of the VSD approach, which explicitly emphasizes ethical and social dimensions of the design process of new technologies. I intend to prove that technically oriented VSD provides a reasonable methodology for designing technology embedding responsibility – the value gaining its momentum in contemporary policy in EU and presumably worldwide. I wish to build on the outcomes of the researchers that examined the role and importance of values, which are universal enough, to apply them throughout the given design area: e.g. computers, machines, infrastructure (Correlje et al. (forthcoming); Flanagan et al. 2005; Friedman et al. 2008; Hoven et al. 2014; Knobel, Bowker 2011; Mander Huits, Hoven 2009; Oosterlaken 2014;). I aim to show that underneath these considerations there is a philosophical concept of responsibility which bears six characteristics. It is collective, future-oriented, socio-political, values-oriented, intuitive and constructive responsibility. Some of these characteristics can be tracked down to discussions in philosophy of technology.

C7

C7.1 PHILOSOPHY OF MEDICINE

Tuesday, August 4 • 17:00–19:00
Main Building, Room 15

Towards a theory of scientific understanding in psychiatry.

De Vreese Leen
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The aim of this paper is to take some steps in developing a philosophical approach to scientific understanding in psychiatry (in its relation to medicine more generally). In the paper, I search for an answer to the question what it means for a psychiatric condition to be "scientifically understood". In order to get an answer to this question, I will deal with further questions, such as: What makes "scientific understanding" in psychiatry "scientific"? What makes scientific understanding of a psychiatric disorder different from other kinds of understanding? What is the place of scientific knowledge and of (personal) experience in the scientific understanding of psychiatric disorders? Is there a distinction to be made between scientific understanding in scientific practice, and scientific understanding in clinical practice? How do these relate? Further, can a psychiatric condition be understood without being explained, or be explained without being understood? And finally, in what sense is the situation different from somatic medicine?

In answering these questions, I will on the one hand rely on the distinction (originating from Karl Jaspers) between psychiatric knowledge which is based in explanations, and psychiatric knowledge which is based in empathic understanding. Further, Kendler and Campbell (2014) recently argued for a third pathway to knowledge in psychiatry, which is supposed to be able to make the bridge between explanation and empathic understanding: "explanation-aided understanding". I will discuss the usefulness of the distinction between these three kinds of knowledge, and show how it can help in developing an appropriate philosophical approach to scientific understanding in psychiatry. On the other hand, I will also rely on the literature on explanatory pluralism from philosophy of science to defend my point of view.

Reference: Kendler, K.S. and Campbell, J. (2014), Expanding the domain of the understandable in psychiatric illness: an updating of the Jasperian framework of explanation and understanding, Psychological Medicine, vol. 44, pp. 1- 7.

The Semantics of Mental Disorders

Vesterinen Tuomas
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There is a long running debate whether the concept of mental disorder is value-laden. I argue that some of the dispute can be dissolved by semantic analysis. The gist of my argument rests on a theory of reference fixing: humans have a natural dysfunction detecting mechanism.

Pascal Boyer (2011) argues that when some mental functions are not working properly they are intuitively detected and deemed as mental disorders the world over. I claim that we also fix reference to some mental disorders intuitively. There are two aspects here: an intuitive detecting mechanism that fixes the reference and culture-dependent explanatory models. The mechanism that detects dysfunctional behaviour is possibly evolutionary selected and makes the reference-fixing process relatively theory and value free. When some behaviour does not match our intuitive expectations, we fix reference to it and thereafter give it varying culture- dependent explanations. A causal theory of reference can explain this since it cuts off the link between descriptions people associate with a term from its reference. On the other hand, some culture relative disorders depend on folk-psychological descriptions. Descriptivism explains the semantics of these terms since it does not allow contradicting descriptions to be attached to the same referent. As a consequence, a member of a linguistic community is not necessarily aware how her term has been fixed and to what it refers. Thus a hybrid theory of reference is needed to account for the use of disorder terms. The upshot of the semantic analysis is that psychiatric research looks for the true referents of folk-psychological disorder terms. The aim is to open the dysfunctional "black boxes" and replace folk descriptions with causal explanations.

REFERENCES: Boyer, Pascal 2011: Intuitive expectations and the detection of mental disorder: A cognitive background to folk- psychiatries. Philosophical Psychology, 24, 95-118.

Remodeling Psychopathology: The Limits of Latent Variable Approaches

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There are several consequences of the DSM approach to classification (i.e., patient heterogeneity, excessive comorbidity, extensive use of NOS diagnoses, lack of specificity of external validators) that are taken to be responsible for the lack of progress in psychiatric research (Hyman, 2010; Lilienfield, 2014). For many, the solution to this problem involves the data-driven development of a structurally valid classification through latent variable modeling (Krueger & Eaton, 2012). The idea is that this kind of classification would map more closely onto the causal structure of psychopathology and thus facilitate research aimed at discovering the underlying causal mechanisms producing overt psychopathology within individuals.

Drawing on recent work in psychometrics, I will challenge this line of reasoning. In particular, I will argue that even if we did find higher-order or bifactor models fitting the data particularly well, there would still be problems with certain substantive realist interpretations of the identified factors, or "mental disorder constructs". Unless the population level models are locally homogenous, and I will argue we don't have reason to assume that they are, the basic problem with traditional psychological constructs and mental disorder constructs alike is that, even on a realist reading, they are multiply realized, etiologically heterogenous, and can only be invoked to explain differences between individuals, not the causal genesis of behavior or symptoms within individuals. That is, there is no one causal mechanism or process representing General Intelligence or General Psychopathology (Lahey et al., 2012; Caspi et al., 2014), for instance, within each individual of the population, even if our models seem to suggest that. Accordingly, we have to look elsewhere, namely to idiographic causal network approaches (Borsboom & Cramer 2013), in order to identify homogenous groups of patients that are likely to be of use in research aiming to find mechanisms causing psychopathology within individuals.

C7.2 PHILOSOPHY OF MEDICINE

Tuesday, August 4 • 14:30–16:30
Main Building, Room 4

Presumption and Prejudice in Diagnostics CANCELLED

Van Droogenbroeck Stephanie
Centre for Logic and Philosophy of Science, Vrije Universiteit Brussel, Brussels, BELGIUM

Quick decisions are made in another way than decisions for which we have more time, i.e. automatic versus controlled thinking. In a clinical setting physicians are supposed to help as many patients in one day. Heuristics –such as presumptions and prejudice- are part of the automatic thinking. We can ask ourselves how presumptions and prejudice play a role in the diagnostic process.

METHODS: A philosophical and ethnographic study (observations and semi-structured interviews) in two Belgian hospitals is conducted. The data is analyzed with the grounded theory approach.

RESULTS: Patients from the Mediterranean area are an important patient group in urban Belgian hospitals. These patients are more vulnerable for Behçet's disease. When a Mediterranean patient present her/himself at the hospital complaining of oral ulcers, the presumption of Behçet's disease rises. Mediterranean patients are also known in these hospitals for more extravert-and even theatrical behavior. This often leads to prejudice and remarks among health care professionals such as "(S)he is just overreacting." We will elaborate this with some examples.

DISCUSSION/CONCLUSION: The presumption is an availability heuristic based on evidence on the prevalence of the disease. The prejudice is a heuristic based on experience and implicit/tacit knowledge transfer from more experienced health care professionals to less experienced professionals. The Behçet presumption and theatrical prejudice lead to quick evaluations of the situation. In a clinical setting this may lead to a quick diagnosis- i.c. Behçet-, or a possible "missing" of a diagnosis due to the prejudice. Health care professionals need to choose between two possibilities:

1) Quick and automatic thinking and accepting the uncertainty as a result of the possible "missing".

2) Controlled thinking –which is more time and effort consuming. This strategy often has a higher cost because of the extra tests that need to be done in order to reduce the uncertainty.

The preference toward identified victims in medical decision making

Zuradzki Tomasz
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It is empirically verified that people do not value lives consistently, prefer to rescue identified individuals rather than statistical (Jenni and Loewenstein 1997), and believe that they should prefer them because of moral reasons. The phenomena were confirmed in idealized situations in which there were no personalizing information like name, gender or age about individuals (Small & Loewenstein 2003). Therefore, the identifiability of the individual per se could be isolated as an independent factor that influences some decisions, in particular rescue decisions. It is an important factor (although not the only one) in explaining why we are relatively strongly motivated to cure ill people, but relatively weakly motivated to contribute to programs that aim to prevent illness (applications to genomic research, see (Garrett 2015)).

In this presentation I will discuss some problems with defining "a statistical individual" and I will focus on a definition that appeals to "counterfactually open process". It is a process in which "there is no fact of the matter about what its outcome would have been if we had not initiated it" (Hare 2012). I will analyze in which way this definition affects an important normative problem: under which circumstances is it morally permissible for people or institutions to yield to the preference toward identified individuals? Some authors (Daniels 2012, Hare 2012) argue that the strength of individual rescue duties are reinforced by the psychological preference toward identified individuals. I will demonstrate that there are no good arguments in favor of this view.

Evidence Based Practice and Expert Judgement in Nursing

Addis Gulen
Faculty of Society and Health, Buckinghamshire New University, London, UNITED KINGDOM

In recent years evidence based medicine has become increasingly influential and has promoted the use of evidence based practice in nursing. The uncritical use of the latter is a cause for concern since its corollary is a tendency to downgrade the importance of expert judgement in nursing. Attempts to imitate standard practice in medicine, particularly randomised control trials, in the area of nursing are potentially problematic. Randomised control trials belong to the category of laboratory based natural science as they deal with statistically verifiable outcomes of particular interventions. Although nursing involves significant medical knowledge it belongs to social rather than natural science with much research being of a qualitative kind. Recognising nursing as social science matters because an unstated presupposition of much evidence based medicine advocacy is that natural science is better than social science and that if social science based fields could resemble natural science rather more in terms of methodology this would represent progress. Such thinking is a legacy of positivist philosophy of science and fails to fully appreciate the complex interdisciplinary of nursing research and practice. The legitimacy of social science research methods in nursing needs to be reasserted through an emphasis on the fundamental limitations on the applicability of randomised control trial methods. The contexts of nursing interventions vary and thus what was effective one in situation may not be so in another and thus expert judgement must continue to have a central role in nursing practice. Furthermore, there is substantial evidence that expert intuition has a notable role in the delivery of effective nursing care. A better understanding of how natural and social science differ would aid many in nursing and healthcare policy to form better agendas for how evidence based practice and expert judgement can work together for the benefit of patients.

An Alternative to the Placebo Concept in Psychotherapy

Green Sydney Katherine
Center for Logic and Analytical Philosophy, KU Leuven, Leuven, BELGIUM

Despite many attempts to create a definition of the placebo concept in psychotherapy that is useful to both theoreticians and practicing clinicians, widespread disagreement persists. As a result, the way in which the term gets used in practice varies wildly from trial to trial, ultimately jeopardizing the results of clinical research. Without a clear standard for how the term should be employed, comparing the results of one placebo- controlled trial to another becomes problematic, if not completely impossible. This difficulty stems from the fact that the placebo concept was originally developed to explain confounding variables in medical trials. Within this context, the term 'placebo effect' refers to a non-physiological, purely psychological, response to treatment.

However, since psychotherapy relies exclusively on psychological responses, this term cannot be made to fit the needs of psychotherapeutic research. When we continue to use the placebo concept, we are forced either to accept that all of the benefits of psychotherapy can be reduced to placebo effects, or to alter the concept to such an extent that it loses all resemblance to its original use. In response to this problem, I propose moving past the use of the concept altogether, and instead construing these 'confounding variables' as responses to the cultural meaning of therapy. To do this, I build upon the framework of Daniel E. Moerman, expanding his insights in medicine to psychotherapy. I argue that, while the placebo concept confuses and hinders research, re-construing reactions to treatment in terms of meaning response better explains why people undergoing treatment experience these effects, and it clarifies how these effects can and should be controlled for in clinical trials. Through my analysis, I open up new possibilities for constructing clinical trials in a way that guarantees reliable and fruitful results.

C7.3 PHILOSOPHY OF MEDICINE

Friday, August 7 • 11:00–13:00
Main Building, Room 3

Measuring the Effectiveness of Medical Interventions

Stegenga Jacob
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Measuring the effectiveness of medical interventions faces three epistemological challenges: the choice of good measuring instruments, the use of appropriate analytic measures, and the use of a reliable method of extrapolating measures from an experimental context to a more general context. In practice each of these challenges contributes to overestimating the effectiveness of medical interventions. These challenges suggest the need for corrective normative principles. The instruments employed in clinical research should measure patient-relevant and disease-specific parameters, and should not be sensitive to parameters that are only indirectly relevant. Effectiveness always should be measured and reported in absolute terms (using measures such as 'absolute risk reduction'), and only sometimes should effectiveness also be measured and reported in relative terms (using measures such as 'relative risk reduction')—employment of relative measures promotes an informal fallacy akin to the base-rate fallacy, which can be exploited to exaggerate claims of effectiveness. Finally, extrapolating from research settings to clinical settings should more rigorously take into account possible ways in which the intervention in question can fail to be effective in a target population.

EBM - a paradigm ready to be challenged

Schulte Marie-Caroline
Philosophy, University of Hamburg, Hamburg, GERMANY

Introduction: Since my PhD work in philosophy of science is about the methodological and ethical problems of evidence- based medicine (EBM), I want to present a paper challenging the current status of EBM by defining it as a paradigm (among others using the Kuhnian definition) that needs to be tackled and surpassed in order for it to become usable for the evidence user.

Aims: The aim is to present a theoretical approach by answering conceptual questions about evidence in order to inform answers in a real world setting. The most important questions would be what actually is 'good evidence' for EBM rather then 'just evidence', and if the hierarchies of evidence are outdated?

Methods: The critical evaluation of evidence in medicine will have to start with the apex of the evidence-gathering methodology, i.e. randomised controlled trials (RCTs). RCTs, albeit having a high internal validity, often display a low external validity, making the extrapolation to the actual target population, let alone the individual patient, almost impossible. The analysis will show how that problem can be tackled and how other forms of evidence can be successfully integrated into actual clinical practice.

Results: Evidence is good evidence as long as it is quantifiable. It does not need to be statistical evidence. The results of RCTs are easy to quantify, but only useful if the population under test is comparable to the target population. Hence, the integration of patients with, for example, multimorbidities, or minorities is essential. Results of trials should be made publicly available in a very timely fashion in order to prevent doubled research.

Conclusion: EBM today should not be understood as the golden rule but as a paradigm that can and should be shifted back to a patient centred care.

The Fallacy of Simple Extrapolation in Evidence-Based Medicine

Fuller Jonathan
Institute of Medical Science, University of Toronto, Toronto, CANADA

The problem of extrapolation in evidence-based medicine (EBM) is this: how can we know whether the treatment's effect size measured in a study is 'transportable' or 'generalizable' to a particular clinical target population? In extrapolating the effect size, we assume that the study population and target population are similar or comparable in relevant ways. EBM's approach to extrapolating the results of an efficacy study is quite simple. We quantify the treatment's effect size using a 'relative effect measure' such as the relative risk (RR). We then presume that the relative effect is transportable to the target population unless we have a "compelling reason" to think otherwise. In the philosophical extrapolation literature, this inference scheme is called "simple induction". In this paper, I raise five objections to the use of simple induction in EBM. 1. It commits a fallacy in informal logic known as the argument from ignorance; absence of evidence (that the two populations are non-comparable) is not necessarily evidence of absence (of non-comparability). 2. EBM argues from empirical evidence that in most instances the relative effect is generalizable; but the argument relies on a weak enumerative induction from a limited sampling of previous instances. 3. There is no mathematical reason for why the RR – as a ratio of event frequencies – should be stable across populations. 4. There are theoretical reasons to believe that the RR – as a measure of some causal property of a population – should *not* be stable across populations. 5. Whether or not we extrapolate the effect size should depend on the level of inductive risk we are willing to tolerate – the costs and benefits of getting it right and getting it wrong. In light of these objections, I argue that simple induction is a fallacious approach to extrapolating the effect size in medicine.

Mechanism-based extrapolation reconsidered

Parkkinen Veli-Pekka
IFIKK, University of Oslo, Oslo, NORWAY

This presentation considers the role of mechanisms in extrapolating causal knowledge in biomedicine. Daniel Steel has argued that mechanisms can justify extrapolation as long as modularity of mechanisms can be assumed. This, according to Steel, will be the case for biological mechanisms that are products of natural selection that favors modularity. I will first present problems for the idea of mechanism-based extrapolation in general. I will then argue that the argument for modularity of mechanisms offered by Steel is not enough to secure mechanism-based extrapolation. This is because the specific modularity-assumptions required for extrapolation depend on the specification of the causal claim being extrapolated, and will thus vary from case to case. For example, if our interest is in the quantitative aspects of a causal relation, stronger modularity- assumptions are needed compared to extrapolation of a qualitative causal claim. These points will be illustrated by a case-study of the use of animal models of ischemic stroke. Even if being largely critical, these considerations also suggest changes to experimental design that might improve the representativeness of animal models. I will conclude by summarizing these suggestions.

C7.4 PHILOSOPHY OF MEDICINE

Wednesday, August 5 • 14:30–16:30
Main Building, Auditorium I

Disease definitions and the case of Morgellons

Quinn Schone Harry
Science and Technology Studies, UCL, London, UNITED KINGDOM

Caplan (1992) notoriously argued that the philosophy of medicine did not engage with matters of interest to medical practitioners. This is typified by attempts to define disease. As Ereshefsky (2009) argues, these accounts – exemplified by Boorse's (1975) naturalist position – have failed in the respect that they do not capture that which is of most interest to health professionals.

In the case of contested diseases, they are unable to perform the one useful task practitioners might expect of them: to demarcate disease in the light of confusing and potentially spurious clinical indicators. ?This paper uses the controversial example of Morgellons to explore how such explanations - in particular (but not limited to) naturalistic ones - fail to adequately explain how a disease concept operates in society or indeed how it could be more useful at helping us treat such conditions. Morgellons is a highly contentious disease which would seem to accord with both naturalist and normativist accounts, but which in reality struggles to achieve legitimacy as a disease. ?

The gap between the philosophy of disease and the manner in which classification occurs in actuality is something that should worry us. This example fits alongside others such as Gulf War Syndrome, Chronic Fatigue Syndrome and Fibromyalgia in demonstrating how attempts to create an all-encompassing 'theory of disease' are futile in the face of the sheer variety of modern disease entities. ? In highlighting these problems, my aim is to move towards more pragmatic, fit-for-purpose models of disease which attempt to address issues associated with classification of disease, conflict resolution as well as throwing new light on thinking about psychosomatic and behavioural conditions.

References: Boorse, C. 'On the distinction between disease and illness' in Philosophy of Public Affairs, 1975, Vol. 5, pp. 49-68. Caplan, A. L., 'Does the philosophy of medicine exist?' in Theoretical Medicine, 1992, Vol. 13, pp. 67-77? Ereshefsky, M. 'Defining 'health' and 'disease" in Studies in History and Philosophy of Biological and Biomedical Sciences, 2009, Vol. 40, No. 3, pp. 221-7

Individuating Pathologies

Krueger James
Philosophy, University of Redlands, Redlands, USA

The definitions of health and disease have been of longstanding interest within the philosophy of medicine. Distinctly less well discussed is how diseases are identified and individuated within organisms. It is one thing to know that an individual organism is sick (some pathology is present); it is another to be able to identify whether one or more different diseases is present, and to understand how and why such diseases are individuated. One underlying disruption within the body can have multiple effects, disturbing the functioning of multiple further parts and processes. In such cases, should further effects be regarded as parts of one disease, or as multiple different pathologies? On this question, medical usage is, in many ways, inconsistent. In some cases, further disruptions are regarded as symptoms of a particular disease (e.g., kidney failure as a

symptom of a specific infection). In others, a specific pathology is regarded as causing a second, separate pathology (e.g., heart disease might cause a further problem, acute kidney failure). Thus, while the causal relationships present would appear to be relevant to disease individuation, an underlying problem simply being a cause of a further disruption is often not regarded as sufficient for both to constitute a single pathology. Ultimately, this paper aims to make progress towards an account of disease individuation. It contrasts "ontological" accounts that would focus on features of the underlying biological structures with "functional" or "physiological" accounts that would emphasize the effectiveness of interventions at different places within the organism. On this latter understanding, the ability to successfully treat a particular disruption independently provides the basis for regarding it as an independent pathology.

Animal Predictions of Human Responses

Atanasova Nina
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This paper defends the notion that biomedical animal models can predict successfully human responses to medical treatments and health hazards against some recent critiques. The thesis is that proofs for the predictive power of animal models are available when their predictive success is evaluated on a case by case basis.

According to a recent challenge, animal models, especially in toxicology and pharmacology, are not reliable predictors of human responses (Shanks et al. 2009). Since the assumption that the reactions of animals to experimental manipulations are similar to those of humans is central for biomedical animal experimentation, this challenge may undermine the validity of basic biomedical practices and thus threaten the legitimacy of experimental biomedical science.

Shanks et al. focus on a few unsuccessful experiments but draw conclusions about animal models in general. However, in a number of cases, well developed and standardized animal models are successful in predicting human responses. This suggests that the predictive validity of animal models should be assessed on a case by case basis. It may be the case that what makes some models successful doesn't work for others. It could also be the case that unsuccessful models are stages in the development of successful models. Because this challenge targets animal models in pharmacology and toxicology, I develop two case studies to show how the predictive validity of animal models is assessed in these fields. The first case analyses the procedures used for the validation of a domestic fowl chick model of the anxiety-depression continuum in psychopharmacology (Sufka et al. 2009, Warnick et al. 2009, and Hymel 2010). The second case focuses on the standardization of a test battery developed for rat models in behavioral teratology and toxicology (Vorhees 1987). These examples show that there are animal models that are quite successful in predicting human responses.

The concept of animal in husbandry and impact on therapeutical choices

Cabaret Jacques
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Fortin Ludivine
Animal health, INRA, Nouzilly, FRANCE

Reification is the general position of animal breeders practising rational (also so called industrial) husbandry: the animal has to be treated well in order that production may reach an optimum. The situation is very similar to the one found in experimental premises for research: animals are treated well in order that they may produce high quality scientific results. In such a world of rationality, the affect may be considered as a deviation from "good practices". It is obvious that treatments for recovering health and production status rely only on wellknown efficient therapeutics, e.g. resources of conventional medicine. One may consider that animals are sentient beings (Singer) and thus husbandry should be reduced as much as possible since we cannot avoid suffering of the sentient beings during their life and at the slaughterhouse. We then use the best resources available of chemotherapy and are thus inclined to prefer conventional therapies. Intermediate positions in husbandry may pretend that husbandry is a part of our culture, that we need animals for food and presence, and thus a good husbandry animal life can be the pretext for animal sacrifice at slaughterhouse (Porcher). In this situation, the farmer is open to risk: risk of killing loved animals, risk of treating his animals with drugs being untested properly for efficacy or toxicity. The non-conventional therapies (phytotherapy, homeopathy, and other alternative medicines) are then preferred. The animal concept is thus a determinant key in the choice of therapies used in animal husbandry.

C7.5 PHILOSOPHY OF MEDICINE

Wednesday, August 5 • 14:30–16:30
Main Building, Room 14

Making Better People through Technologies and Without Norms - Disciplinary Transfers from Medicine to Enhancement

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Favereau Judith
Political and Economic Studies, University of Helsinki, Helsinki, FINLAND

The key concept in the literature of biomedical enhancements is making better people by the use of such technologies. It is suggested that many characteristics such as intelligence, optimism, self-discipline, a sense of humor, or general well-being, could be increased by the use of genetic engineering or chemical neuroenhancement. In this paper, we examine the disciplinary paradigm of biomedical enhancement. The paradigm of enhancement situates itself in the discipline of medicine, but it remains a question whether it shares any relevant epistemological and normative framework with medicine. Therefore it is of importance to locate this disciplinary paradigm within the one of medicine. Medicine has a long history, and even if it is not a unified discipline, its object appears clear: cure individuals by making them reestablish their normal sate. Indeed, medicine is defined by both the clinic (defining a disease through a diagnosis) and the therapeutic (assessing a remedy).

While, enhancement paradigm focuses mainly on technologies that should improve the life of individuals. By doing that, enhancement paradigm escapes from normative questions constitutive of medicine, allowing such paradigm appearing free from normative aspects and then being neutral. In this paper, we exhibit the disciplinary transfers between these two paradigms showing that enhancement only borrows from medicine the remedy-oriented language evacuating the diagnosis one, leaving the objects of the paradigm undiagnosed as if there was a common agreement on their definitions. In the second section, we examine the implications of such disciplinary transfers by questioning the hidden norms of enhancement. Hence, we urge the enhancement paradigm to build, through the use of other disciplinary transfers, the diagnosis part which is missing and weakening its suggested power in improving individual lives.

How Modern Technology Shapes Death

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Modern technology refers to the scientific technology which is contrary to experiential technology.

Nowadays, scientific technology is involved in our life and way of being. Every aspect of modern society is shaped by scientific technology, including death. For example, people die in hospital currently instead of at home. By analyzing the phenomena and elements related to death, and exploring how modern technology shapes death, a new critical way of understanding contemporary civilization is probable. As for China, which is part of the global chain of industrial civilization of the world, modern technology fundamentally reshapes its national political, social management, medical system, family structure, the ideology, and death status inevitably. The contemporary statuses of death in China and in western countries share a lot of similarities, but those of China has its own characteristics. Nowadays in China, the related researches such as philosophy, medicine, anthropology have put much emphasis on traditional culture, ethics, medical treatment of life and hospice, etc. But what is the truth of modern death? In the societies dominated by modern technology, why economic growth is not equal to the improvement of the quality of death? It is necessary to anatomize some more complicated and underlying causes such as the local change of the proportion of the death causes, the health care system, the registration system of death, assembly line of funeral ceremony, even the role of mass media in the process of science edged out religion and customs as ideology about death. Death is an epitome of modern civilization, so it will also enables us to und rstand the deep roots of other social problems at present in China.

Perceptual Knowledge of Nonactual Possibilities

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Of a certain cup before me, I can know that it is metaphysically possible that I hold it, even if I am not holding it. Of a certain ball being thrown at me, I can know that it is metaphysically possible that I catch it. Why and how are these cases of modal knowledge possible? This paper addresses these questions in order to reach results about the epistemology of metaphysical modality (and, given the centrality of metaphysical modality to philosophy, the epistemology of philosophy). Most obviously, the examples refute a wide-reaching form of modal skepticism, which denies that knowledge of nonactual possibilities is ever possible. Less obviously, they complicate the roles experience and counterfactual thinking are supposed to play in an account of modal knowledge. Many views about the role of experience in an account of modal knowledge imply that knowledge

of nonactual possibilities cannot be had by sensory perception. For example, of conceivability, Yablo says: “if there is a seriously alternative basis for possibility theses, philosophers have not discovered it” (1993: 2). I argue that my examples refute views such as Yablo’s. Visual and other sensory perception provide an alternative basis for many possibility claims, including nonactual possibility claims. The examples also show that Williamson (2007: ch. 5) overstates the significance of the logical reducibility of metaphysical modality to counterfactuals for the epistemology of possibility. An account of our knowledge of my examples does not require us to assume Williamson’s logical equivalences between metaphysical modal and counterfactual claims. Moreover, the method we are employing is different from the imaginative method for counterfactuals Williamson sketches.

C8

C8.1 METAPHILOSOPHY

Thursday, August 6 • 17:00–19:00
Main Building, Auditorium IV

The Epistemology of Modality and the Method(s) of Philosophy

Rusu Mihai
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Kripke's distinction between metaphysical and epistemic modalities is widely accepted among contemporary philosophers and is often employed as a tool for driving forward (broad or specific) realist theories and arguments. However, Kripke does not provide an account of how we arrive at knowledge of metaphysical modality and the task of providing a successful or at least a minimally controversial modal epistemological account seems very hard to fulfill. This is not to say that there have not been attempts to propound acceptable itineraries to metaphysical modality in accordance with Kripke's views. Notably, Soames's account aims to deliver real necessity out of the space of epistemic possibilities, an attempt that, I argue, falls short of reaching its goal. This failure has to do with an underlying tension between orthodox Kripkean views in the philosophy of language (the way we achieve reference) and Kripke's own proposals of restricting the ways we imagine objects in counterfactual situations. At the same time, our views on metaphysical modality are strongly related to the views we hold on the nature and role of philosophy. Notably, Williamson maintains that metaphysical modality is central and specific to philosophical inquiry, but our knowledge of this type of modality is a byproduct of our naturally-developed cognitive capacity to entertain counterfactuals. As a result, philosophy is not an activity that is fundamentally different from scientific or day-to-day inquiry. While I regard Williamson's broadly naturalist solution as preferable for this reason to rival realist theories about modality (moderate rationalism or robust essentialism, which still lacks a full-fledged epistemological development), I argue that it is unclear whether it suffices to ground metaphysical modality. As a consequence, this paper explores alternative, non-realist views concerning metaphysical modality, the challenges they must take up and their bearing on meaningful (re)drawings of the a priori – a posteriori distinction.

Philosophy Disputes, Defectiveness and Responsiveness to Reasons

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Some disputes seem just defective, that is idle, not worth pursuing. Taste disputes are seemingly a paradigm of this kind of defectiveness. Sometimes, though, we feel that a similar pointlessness affects other disputes, among which philosophical ones. For instance, suppose David and Peter are having a dispute about whether free will is compatible with determinism. Each of them utilizes the best arguments at his disposal to challenge the opponent's theory and to support their own proposal. Yet, neither of the parties ultimately changes his views as a result of the arguments articulated by the other. Once the arguments have ran out, the intuition seems to be that the dispute is not worth pursuing (at least for the moment). Interrupting the dispute seems reasonable, for there is little or nothing that each participant could add to change the opponent's doxastic situation.

My aim is to explain the rationality of dispute interruption. I claim that, in the cases under consideration, whatever reasons each of the parties has to believe a certain proposition p, these reasons block appreciation of those reasons that would recommend believing a proposition q incompatible with p. Ultimately, the dispute is defective (not worth pursuing) because neither of the participants is responsive to a certain class of reasons, which are exactly the reasons that the opponent has for her incompatible belief. My discussion will touch the following issues: (a) is the parallel between taste and philosophy disputes accurate, or in any way fruitful? Is it sensible to provide a rational reconstruction of how a dispute is (or comes to be) defective?; (b) What is the epistemic nature of the non-responsiveness involved in defective disputes?; (c) How does the defectiveness of disputes relate with phenomena such as verbal disputes, faultless disputes or peer disagreements?

On the difficulties of saying 'what is an inference'.

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Forgács Gabor
Budapest University of Technology and Economics, Budapest, HUNGARY

In our talk we propose arguments contesting the idea that the nature of our inferences can be understood on the grounds of intuition since the metaphilosophical talk of intuitions in this context leads to confusion. First, it feeds the illusion of an incontestable starting point, either by reference to intuited facts, or by reference to the fact that we intuit. We agree with the view that no such starting point can be established. Furthermore, grounding inference on intuition obscures the relation between philosophical and everyday thinking. While it is true that intuitions involve the very same cognitive capacities that we use in the rest of our thinking, they are deployed in contexts in which scepticism about judgement is salient. The grounding of inferences on intuitions disguises the differences between their conditions of adequacy.

Boghossian (2014, 5) argues that an inference should be characterized in terms of what he calls the taking condition: "Inferring necessarily involves the thinker taking his premises to support his conclusion and drawing his conclusion because of that fact." He explains the taking condition as something rooted either in the sub- personal level of cognition or in blind rule following. Choosing either of these options makes it impossible to distinguish inferences from other trains of thought.

We argue that the nature of inference should be understood as an action with an aim to arrive at a certain conclusion. Furthermore in a dialogical setting, inference should be understood as an action of the speaker to establish the truth of the conclusion from the premises and thereby issuing an intersubjective licence for the interlocutor to oppose this. Reasons for carrying out a certain inferential step are grounded in the dialogical settings for the participants of a certain dialogue.

C8.2 METAPHILOSOPHY

Thursday, August 6 • 11:00–13:00
Main Building, Auditorium IV

The Normative Aspect of Naturalistic Philosophy of Science

Tulkki Leena
Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

The aim of this paper is to lay ground for meta-philosophical discussion about the normative dimension of current philosophy of science. After the naturalistic turn in the 90's, many philosophers of science consider empirical information about scientific practice essential for their theorizing. Lately some philosophers of science have used experimental methods to study scientific concepts such as gene and innateness. This trend towards more empirically oriented research raises a question: how does naturalistic philosophy of science differ from scientific, i.e. sociological, studies of science? One answer is that philosophy of science, even in its naturalistic form, has a distinctively normative dimension.

However, scientists themselves engage in debates about meta-level issues concerning their own field, including normative questions about how research should be done. Just as descriptive philosophy of science should, for a naturalist, form a continuum with scientific science studies, perhaps normative philosophy of science should also be connected to the actual concerns of scientists. This seems to not always be the case, as some naturalists have pointed out. If philosophers of science want to make useful normative contributions to science, they need to integrate their work to the meta-level discussion already practiced in the particular fields of science and justify their normative claims in a way that the community of scientists in that field would find plausible. I will discuss the role of philosophers in this scenario and the implications for the field of philosophy of science as a whole.

Philosophy is Alive and Well: Who's Afraid of Intertheoretic Reduction?

Apolega Dennis
Philosophy, De La Salle University Manila, Manila, PHILIPPINES

The status of philosophy has been put to question, but more recently with Stephen Hawking's pronouncement that philosophy is dead. However, philosophers have argued that the there is a chasm regarding the concerns of philosophy and the concerns of science. Philosophers like Thomas Nagel take this chasm to show what is distinctive about philosophy from science. For Nagel, this is a distinction with a difference for it highlights the autonomy of philosophy. If philosophers like Nagel are right then Hawking would be wrong. Hawking's pronouncement would follow if it is true that physics has taken over the concerns of philosophy.

Hawking might not be aware of it but his pronouncement, barring inaccuracies regarding philosophers not keeping up with advancements in science, depends on one of purported implications of intertheoretic reduction. Indeed, the resistance to intertheoretic reduction can be situated within some of the fears surrounding intertheoretic reduction. One can be located in Nagel and the distinctness of philosophy from science, for what would philosophy be if it were not distinct? Another would be physicalism and some of the implications that it entails. Another philosopher who has voiced similar fears is Alvin Plantinga.

This paper contends that there need not be such fears. To support this view, Mayr's (1988; 2004) views on the autonomy of biology will be discussed while keeping aware of the intricacies of intertheoretic reduction and the implications of physicalism. Canonically one usually turns to philosophical discussions of issues raised by physics; perhaps it is time for philosophy to take its cue from biology.

Rather than thinking of these fears as leading to the death of philosophy, the paper views the issues raised by intertheoretic reduction as reinvigorating philosophy in general, with philosophy of science as the fertile ground for further renewed discussions in metaphysics and epistemology.

Philosophy as "anything goes": A Critical Analysis of the Problem

Gebura Blazej
Department of Philosophy, John Paul II Catholic University of Lublin, Lublin, POLAND

Some thinkers claim that the choice of philosophical methods is highly arbitrary. For example, Nicholas Rescher defends the view in which there are many of equally good methodological orientations in philosophy. In my presentation I want to discuss possible formulations and metaphilosophical consequences of such claim. The latter would be the relations between such view and the question of the nature of philosophical arguments. I want to show, how accepting such "Anything goes" claim would affect the possible answers for philosophical investigations on what arguments of philosophy are. To do so, I will make some comments on the antoher profound question: What kind of discipline is metaphilosophy.

Can the metaphilosophy of cybersemiotics solve the paradox of transdisciplinary frameworks of Wissenschaft?

Brier Søren
International Business Communication, Copenhagen Business School, Copenhagen, DENMARK

Human beings are embodied, feeling, knowing, and culturally formed conscious beings interacting through semiosis and language processes living simultaneously in four incompatible worlds: 1. The physic-chemical part of the natural world, which also constitutes the pure material-energetic aspect of our body.

2. A living feeling body, a prerequisite for cognition and communication we share with other living species. 3. An experiential world of feeling, will, drives, affects, and thoughts, manifested as conscious-

ness. 4. The cultural world of signs and language connecting our perception with our thinking, communication, and acting in the social world. But unfortunate each of the four worlds has historically developed its own type of narrative, with its own fundamentalist and reductionist versions vitiating the project of transdisciplinarity. Physicists and chemists tend to view the universe as consisting of matter, forces, and energy. Cybernetic and semiotic oriented biologists perceive living systems as the basic organizers of reality, possessing self-organizing, self-protecting, self- promoting abilities (autopoiesis) creating instinctively based perception and communication through signs. The social and cultural sciences, especially the radical social constructivist ones, see the world as constructed from social, human, and linguistic interpretations. This is why energy-matter-information, life, consciousness, and meaning become separated in four different worlds of knowledge. We lack a transdisciplinary, 'scientific' explanation of how they can possible be integrated in a meta-framework, as it is accepted in all four 'worlds' that the 'unity of science' idea of the logical positivists failed because it was predicated on the excessively narrow epistemological foundation of verificationism. The precursor of Popper's fallibilist critical rationalism, namely the fallibilism of C. S. Peirce's semiotic pragmaticism may, if integrated with autopoietic system theory of Luhmann pave the way for a Cybersemiotic process view (Brier 2008) as one possible meta-framework encompassing phenomenological, hermeneutical, biosemiotic as well as post-positivist natural science.

C8.3 METAPHILOSOPHY

Saturday, August 8 • 10:00–12:00
Main Building, Auditorium II

Carnap's Radical Way Out

Creath Richard
School of Life Sciences, Arizona State University, Tempe, Arizona, USA

Philosophers nowadays disagree, or seem to, in every conceivable way. They disagree about what they ought to be doing and on how to do it. They disagree about what they can take for granted and about what sort of results might be expected or hoped for. Does philosophy have its own evidence, and can it find its own facts? And what are its relations to the empirical sciences or other human endeavors? Today there is no consensus on the answers to these metaphilosophical questions. And that lack of consensus is in itself worrisome. If philosophers cannot agree among themselves, why should anyone else take them seriously? Given this, it is hardly surprising that philosophers are reflecting on the character and methods of philosophy itself.

Carnap worked in a time much like ours. There was then no consensus on any of the mentioned issues, and his most important philosophical contribution was a response to that situation. He recognized that some disagreements are only verbal. And he saw that a valuable objectivity can be achieved that what we say is said is said in some particular language and that we are not all using or proposing to use the same language. We might each be right but talking at cross-purposes. Thus, there is a way – a radical way – that might diffuse philosophical disagreement. Indeed, it might avoid fundamental and apparently intractable philosophic disagreement altogether by reconstruing these apparent theoretical disagreements into differences of linguistic strategy. Carnap's radical proposal was not fully understood in his lifetime. This paper gives some reasons why Carnap's radical way out is worth our consideration now.

Carnap's Metaphilosophy

Carus André
Philosophy, Hegeler Institute, Chicago, USA

Carnap's Metaphilosophy The elimination of metaphysics was Carnap's best-known agenda item. But recent decades have seen a strong revival of metaphysics, especially among analytic philosophers. Has the new analytic metaphysics overcome Carnapian scruples or merely ignored them? Did Quine, Putnam, Lewis, Kripke, or someone else show that such scruples were groundless? Or does Carnap's own principle of tolerance actually require him to countenance our analytic metaphyics, as some think, since it respects the limits imposed by science? These are not purely historical questions but also concern metaphilosophy more generally. A recent example is Timothy Williamson's defense (in his 2007 book The Philosophy of Philosophy as well as subsequent writings) of a program of metaphysical research, but without considering Carnapian, or logical empiricist, arguments against all metaphysics in principle. Williamson assumes that his project of "undoing the linguistic turn" undermines all such arguments. However, the "linguistic turn" that Williamson seeks to "undo" (i.e. that he presents arguments against) is the Fregean one promoted by Michael Dummett, and not the specifically Carnapian linguistic turn introduced in Logical Syntax of Language. This paper shows that the Carnapian linguistic turn does not depend on the Fregean one. In fact the Carnapian one, as detailed research over the past fifteen years has established, was developed specifically in opposition to the Fregean form of linguistic turn. And the Carnapian linguistic turn is a much more powerful basis for Carnap's argument against metaphysics than the Fregean one. However, it appears, as this paper will argue, that the Carnapian form of linguistic turn has been almost entirely ignored by analytic metaphysicians, despite frequent invocation of Carnap in debates about meta-ontology, verbal disputes, and other questions of meta-metaphysics. It would thus appear that analytic metaphysics is no less vulnerable to Carnap's critique than older kinds of metaphysics.

Carnap, Cassirer, Schrödinger and the Hypothesis P

Ikonen Sirkku
Department of Philosophy, History, Culture and Art, University of Helsinki, Helsinki, FINLAND

The starting point of this presentation is Erwin Schrödinger's and Rudolf Carnap's debate concerning the reality of other minds and presuppositions of science (Schrödinger, E.,"Quelques remarques au sujet des bases de la connaissance scientifique", 1935; Carnap, R., "Existe-t-il des prémisses de la science qui soient incôntrolables?", 1936). According to Schrödinger, the postulation that not only I, but also other persons have thoughts and perception, is the precondition of science. He calls this postulate the Hypothesis P (P standing for personality). As the Hypothesis P is a precondition for the possibility of science, it is not empirically testable nor is it based on convention. In his reply to Schrödinger Carnap argued that any presupposition underlying science, must be scientifically, i.e., empirically testable. Statements concerning the reality of other minds are, however, not empirically testable and meaningful. When Schrödinger's and Carnap's articles in the mid 1930's, the debate went largely unnoticed. Ernst Cassirer's recently published Nachlass (Symbolische Prägnanz, Ausdrucksphänomen und 'Wiener Kreis', 2011), sheds a new light on the debate on Hypothesis P and the foundations of science. Cassirer agrees with Schrödinger on the demand of Hypothesis P. Referring to Russell's type theory, Cassirer argues that Carnap's main mistake is confusing the object of science with science itself, and failing to see that science is cultural phenomena. Cassirer bases his argument on the analysis of the concept of perception. In this presentation I will explore and evaluate Schrödinger's, Carnap's and Cassirer's views on the problem of other minds and the foundations of science. I will suggest that Cassirer's argument is further reinforced if we approach the question concerning the Hypothesis P with the semantical tools developed by Jaakko Hintikka (language as calculus vs. language as a universal medium – distinction).

Wittgenstein on the Impossibility of Illogical Thought

Appelqvist Hanne
CoE Reason and Religious Recognition, University of Helsinki, University of Helsinki, FINLAND

In the Tractatus, Wittgenstein writes that 'what makes logic a priori is the impossibility of illogical thought' (TLP 5.4731). Further, according to him, every proposition is legitimately constructed, and whatever is possible in logic is also allowed (TLP 5.4733 & 5.473). This paper gives and interpretation of these remarks from the perspective of the Kantian interpretation of Wittgenstein's early thought. It will argue that the logic as conceived by the early Wittgenstein is 'transcendental' (TLP 6.13) in the full-blown Kantian sense of being (i) about the necessary a priori conditions for the possibility of sense (TLP 2.18, 5.4731); (ii) universal by being the form of thought and of every imaginable world (TLP 2.022); and (iii) tied to the metaphysical subject (TLP 5.61, 5.632). The paper concludes by addressing the question of the possibility of error. If logic is constitutive of thought, as Wittgenstein explicitly claims it to be, i.e., if every meaningful proposition is already legitimately constructed, then what is the point of Wittgenstein's self-proclaimed and normative enterprise in the Tractatus, namely to 'draw a limit to thought' (TLP 4.114 & p. 3). The answer to this question requires once again a revisit to the Kantian background of Wittgenstein's thought. Or so it will be argued in the paper.

COMMISSION SESSIONS

SESSION OF IASCUD - SCIENCE AND CULTURAL DIVERSITY: INTEGRATING HISTORICAL AND PHILOSOPHICAL ASPECTS

Tuesday, August 4 • 11:00–13:00 (Session I)
Tuesday, August 4 • 14:30–16:30 (Session II)
Main Building, Room 7

Organizer:
Ito Kenji
President IASCUD

Description of the Symposium

The International Association for Science and Cultural Diversity (IASCUD) was founded in the year 2000 and became a commission of the Division for the History of Science (DHS) in the following year. It has set itself the task of developing a critical analysis of culturalist trends that gain momentum in the field of the history of knowledge. By contrast, IASCUD seeks to promote a new understanding of what may be conceived as "cultural diversity" in relation to science. This requires bringing a global approach to the study of science and scientific practice, and taking into account the diversity of scientific cultures across the globe. IASCUD aims at bringing together all those who are convinced that a global approach to the history of knowledge provides the right framework for a fully theoretical approach to science and technology.

Until recently, the work of IASCUD has been focused on the history of science. However, philosophical and methodological issues also prove vital to fulfill the goals IASCUD has set itself. Accordingly, IASCUD aims to become an inter-division commission of both of the divisions of the International Union of History and Philosophy of Science (IUHPS). The request to be commissioned by DLMPS will be discussed during this years DLMPS General Assembly in Helsinki.

Our symposium aims at highlighting the relevance of conjoining historical and philosophical work to approach cultural diversity in the study of science. It will bring together members of the IASCUD Council reporting on IASCUD activities and researchers who represent the confluence of philosophy and history of science in the study of cultural diversity.

Program

Session One

• "The role of (visual) representations in mathematics," by Jessica Carter (University of Southern Denmark, Odense, Denmark)

• "An appraisal of presenting mathematics in metrical form from a socio-cultural perspective," by Krishnamurthi Ramasubramanian (Indian Institute of Technology, Bombay, India)

• "On the project 'Culture of Mathematical Research Training'," by Benedikt Löwe (Universiteit van Amsterdam, The Netherlands & Universität Hamburg, Germany & University of Cambridge, England; Assessor of IASCUD)

Session Two

• "Science and cultural diversity: the problem of Orientalism,"by Kenji Ito (The Graduate University for Advanced Studies, Hayama, Japan; President of IASCUD)

• "Same ascriptions, different methods?" by Smita Sirker (Jadavpur University, Kolkata, India)

Abstracts

The Role of (Visual) Representations in Mathematics

Carter Jessica
Department of Mathematics and Computer Science, University of Southern Denmark, DENMARK

The use of diagrams (or more broadly visualisation) in mathematics has recently attracted a lot of attention, and scholars have pointed to the many different roles they play. It has been shown that visual tools may further students' understanding when teaching mathematics, and that diagrams can function as tools for discovery. In addition it has been debated whether diagrams can be used to obtain rigorous proofs. In this talk I wish to discuss issues related to the second role, that is, the roles diagrams play in relation to reasoning in mathematics and in particular in discovery. I will start by noting some of the roles scholars have attributed to the diagrams in Euclid and show that one may also find similar uses of diagrams in contemporary mathematics. Furthermore I wish to stress the capacity of diagrams to display relations. In order to address the question why diagrams are fruitful in mathematical reasoning, I wish to draw on Peirce's semiotics. Peirce stresses the importance of icons (i.e., signs representing because of likeness) in mathematics, saying that: "For a great distinguishing property of the icon is that by the direct observation of it other truths concerning its object can be discovered than those which suffice to determine its construction" (CP 2.279). A diagram, according to Peirce, is a particular icon, namely an icon representing a relation. Because of this usage, Peirce characterises mathematical reasoning as diagrammatic reasoning. Combining this usage with Peirce's statement concerning the fruitfulness of icons, it would seem that the fruitfulness lies in the possibility to display relevant relations rather than the stress on visualisation.

COMMISSION SESSIONS

An Appraisal of Presenting Mathematics in Metrical Form from a Socio-Cultural Perspective

Ramasubramanian Krishnamurthi
Indian Institute of Technology, Bombay, India

In this era of e-learning and m-learning, when mobile phones, MP4 players, notebooks and tablets, are gaining currency as educational aids, it may sound quite weird to think of learning mathematics through metrical verses, which is completely devoid of symbols and notations. However bizarre and weird it may sound, from time immemorial, this has been `the-mode' of learning in India for several millennia, till recent times. The savants of the past had mastered the technique of effectively communicating their ideas, without facing any constraints in the form of beautiful metrical compositions in Sanskrit, irrespective of the branch of learning---art, architecture, astronomy, law, logic, philosophy, music, medicine or mathematics.

The art of blending mathematics with poetry, had been in place in India at least from the time of Vedanga Jyotisha (c.~1400BCE) of Lagadha. One of the primary reasons (while there could be others) for taking recourse to poetry, is to make the medium of communication, as beautiful as the message. The ancient Indians also chose to be brief in their style of writing, and certainly avoided excessive verbiage. It is said of Indian grammarians, that even if they could manage to save half a mora or syllable from one of their rules, they celebrated it like the birth of a son. Of course, enough care was taken to see that brevity does not mar the clarity or accuracy.

The ignorance about a particular tradition, clubbed with inappropriate appraisals in the literature has resulted in a critical failure to appreciate the fact that there could be `varied' approaches that are equally `valid' to arrive at the same truth. This made some of the historians of mathematics, decry other approaches. During our talk, we intend to highlight some of these issues and features described above. We will also try to touch upon the fact that mathematics, as well as other scientific theories in general are socially constructed principles---and not mind independent entities---and hence are bound to have cultural variations.

The Project "Culture of Mathematical Research Training"

Löwe Benedikt
Universiteit van Amsterdam, The Netherlands & Universität Hamburg, Germany & University of Cambridge, ENGLAND
Assessor of IASCUD

This talk will report on the project Cultures of Mathematical Research Training which was run by the International Union for History and Philosophy of Sciences and funded by the International Council for Science (ICSU). This project brought together researchers from the field of Studies of Mathematical Research Practice and representatives of the society stakeholders, e.g., funding agencies, to discuss important research questions in the study of mathematical research training (i.e., in particular the doctoral training of future Ph.D.s in mathematics).

Science and Cultural Diversity: The Problem of Orientalism

Ito Kenji
The Graduate University for Advanced Studies, Hayama, JAPAN
President of IASCUD

This talk discusses one of the issues that the International Association for Science and Cultural Diversity (IASCUD) has been tackling with: the issue of Orientalism. In recent decades, the international community of the history of science has greatly expanded its geographical scope by producing many studies on regions outside Europe and North America. If, however, a study on science in such a region, aims to get much attention from the majority of historians of science, who do not studies that region, it is often advantageous for such a study to emphasise that the region in question is different from Europe or North America. Since novelty is one of the important measures of the value of research, if a study finds that something is different from what is already known, the study tends to be considered more interesting. This encourages a tendency of Orientalism, because if a study receives attention from a larger scholarly audience, it becomes more visible. Such Orientalistic studies can be highly problematic, because they overemphasise and essentialise cultural differences. They sacrifice scholarly integrity for the sake of appeal to a larger audience and, by so doing, overshadow more careful studies that try to draw more nuanced pictures of different cultures in science. Thus, the very expansion of the geographical scope of the international community of the history of science, which should be in principle a good thing for cultural diversity, can make it more Orientalistic. In this talk, I will discuss how to deal with this problem.

Same Ascriptions, Different Methods?

Sirker Smita
Department of Philosophy, Jadavpur University, INDIA

What is more desirable for a cognitive scientist, a cognitive psychologist, or a philosopher? Do we implicitly harbour the belief that any cognitive theory, say a theory on reasoning in general or theory on moral reasoning, fits with any randomly given cognitive agent, irrespective of cultural and social variations that are empirically observable to us. What is the core assumption(s) that have led philosophers and many others adhere to the conviction that theories are universal in their application. More importantly, theories that commit on the internal cognitive processes of our cognitive system – rests on the conjecture that there is an extensive sharing of our cognitive architecture and system, across any given culture and history. Thus, the core cognitive processes are taken to overlap if not merge in their various aspects. Honestly, it is very difficult to disprove such assumptions, given the nature of the issue.

However, we are increasingly becoming aware that theories must entertain a scope for liberal interpretation. Theorists must be ready to grant the possibility that any given theoretical posit bears a chance of variation – when they are applied empirically by us. Experimental philosophy is gaining credible grounds over the last decade, as it is trying to lessen the gap between the claims of theory and data from practise. They are trying to build bridges and test whether, say our metaphysical, epistemological or moral theories are reflective of our folk intuitions regarding metaphysical, epistemological or moral issues. For example, experiments have been conducted to test - whether folk moral intuitions do converge with posits of moral theories.

Such studies have led to very interesting results. Recent empirical studies have begun to focus not just on theories and folk intuitions; but also whether there are any differences in folk intuitions across cultures. In this paper, I would like to present and discuss some core issues regarding such empirical research and their significance in theory building. Furthermore, how far are we justified in our cognitive ascriptions and judgements pertaining to any random cognitive agent, of any cultural background?

TEACHING COMMISSION - INNOVATIVE AND EFFECTIVE TEACHING IN UNDERGRADUATE PHILOSOPHY OF SCIENCE AND LOGIC

Tuesday, August 4 • 17:00–18:00
Main Building, Room 13

Convenor:
Matthews Michael R.
School of Education, University of New South Wales, AUSTRALIA
m.matthews@unsw.edu.au

This session is sponsored by the Interdivisional Teaching Commission of the DHST/DLMPS to enable presentations on innovative and effective undergraduate teaching of philosophy of science and logic. Presenters will share good, engaging and effective approaches to undergraduate classroom and web-based teaching of the disciplines. Presentations will cover curriculum, materials, texts, classwork, assessment, use of social media, and other means that have been found in practice to promote more engagement, interest and learning of philosophy of science and logic.

Teaching Logic to undergraduate students in Psychology with Moodle

Monroy-Nasr Zuraya
Psychology Department, National Autonomous University of Mexico, MEXICO
zuraya03@gmail.com

Logic (propositional calculus and predicate calculus) along with Philosophy of Science, have long been part of the curriculum for undergraduate studies in Psychology. I teach these subjects for students in an open university system. This means that students are “self-taught”. During the last decade, the use of platforms has been an important aid to transfer study materials and to interact with our students.

Although students take one course on Logic in high-school, they seldom retain any basic and useful knowledge. Moreover, students enroll in Psychology trying to avoid formal sciences and in search of a practical education.

The Moodle platform has several features that allow us teachers to present structured materials (like study guides) and texts, not only to complete the programme, but more importantly to give the students' self instruction a scaffold for successful learning.

Teaching with Argument Maps

Soysal Zeynep
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soysal@fas.harvard.edu

An argument map is a visual representation of support relationships between claims in an argument. It provides an easy-to-read visual representation of an argument, and thereby enables precise evaluation of the reasoning and claims in that argument.

The skills that go into producing an argument map are all component skills of advanced philosophical thinking. For instance, to produce an argument map one needs to locate claims within a text, and understand their role within a broader argumentative structure. Furthermore, to map a *logically valid* argument, one needs to add (often implicit) premises to the argument map and determine logical validity.

There is some recent evidence that teaching philosophy with argument maps dramatically increases students' analytical skills. In my experience, at least, students are also really excited about argument mapping. In this presentation, I will explain the basics of argument mapping, and give a few ideas for integrating argument maps in philosophy assignments (both traditional and non-traditional) and in-class activities. I will also give some strategies for scaffolding argument map exercises.

Teaching Philosophy of Cognitive Science

Rusanen Anna-Mari
Philosophy Department, University of Helsinki, FINLAND
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This presentation will outline, how the empirically based findings of conceptual change studies can be applied in didactics of philosophy, and in philosophy of science in particular. In the conceptual change paradigm, learning of scientific content is seen as a replacement of everyday commonsensical frameworks with new more sophisticated and theoretically deeper ones. In other words, learning is seen as a specific kind of process, in which learner´s conceptual system undergoes a restructuring process that affects ontological commitments, inferential relations, and standards of explanation. Thus, in conceptual change the difference between the initial state and the outcome of learning is not merely accumulation of knowledge and rejection of false beliefs. Instead, the students' conceptions of phenomena in a domain undergo a holistic restructuring process, leading to acquisition of scientific concepts and a reorganization of the students' web of beliefs from a fragmented set of commonsense beliefs to a consistent web of scientific conceptions. Examples will be given of how the design of didactics can support this learning process in philosophy class rooms.

COMMISSION SESSIONS

Linking Philosophy and History in a Unified Story: How Epistemology of Science Emerges from Scientists' Biographies.

Bertolaso Marta
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One of the most important aspects in the experimental design and scientific practice is to find the adequate explanatory level for a given phenomenon. This epistemological issue asks for a deeper analysis and understanding of the role of what we call 'human factor' in scientific practice. In the presentation we offer some examples of how history of science has shown that such 'human factor' actually plays a crucial role in producing revolutionary innovation in biomedicine, technology and medicine: e.g. no stethoscope, nor any other biomedical diagnostic tool, without the modesty of René Laennec; no Atlantic Cable, nor modern telecommunications, without the tenacity (and the money!) of Cyrus Field; no cardiac surgery without the encounter of two borderline visionaries such as Alexis Carrel and Charles Lindbergh; no *Apple*, nor computer graphics without the awkward fondness of Steve Jobs for very old-fashioned calligraphy; and, probably, no spectacular rise in the twentieth century American medicine, without the sympathy and the ability to inspire of William Osler. As insidious as it can be, we think that the biographical approach can prove to be a valuable introduction to philosophical and epistemological insights in the evolution of science and technology and in particular to teach our students why the most relevant issue in scientific practice is to ask the right question and to choose the right model.

Elements of Critical and Computational Thinking in Education of Pre-school Children

Bożek Hubert
Department of Logic and Methodology of Sciences, Institute of Philosophy and Sociology, Pedagogical University of Cracow, POLAND

In my presentation I wish to share some observations regarding the education of pre-school children in the areas of problem solving, critical and computational thinking as part of FiloZosia project. The key question I am willing to address is whether certain techniques used in our project can be applied in teaching subjects such as Logic or Science Methodology to undergraduate university students. FiloZosia (from: *Zosia* - a Polish diminutive term for *Zofia* ñ eng: *S ophie*) is an experimental educational scheme based on learn-through-play concept. The project in question Is currently at the stage of development. It will be carried out in the form of workshops or games, the first set of which is scheduled for June 2015. The aim is to encourage children at the early stages of their education to try and solve some intellectual riddles, which in the world of grown-ups are generally known as philosophical. The games will address various topics, which constitute following modules:

(1) ëI amí (identity)
(2) (2) ëI observeí (experience and cognition)
(3) (3) ëI thinkí/íI knowí (knowledge and justification)
(4) (4) ëI actí(praxeology and ethics)

In my presentation I will focus on third module. Here the emphasis will be laid on the practical application of self-correction procedures and the formulation of some very basic rules concerning the correctness of our reasoning. Children will be presented with a ëbrokení toy built of plastic blocks, and will be encouraged to fix it. Thus they will learn to analyse its constructional patterns. At the same time they will be asked to build their own narrative concerning their actions and to justify them. This narrational aspect of the game marks the transition between extensional and intesional contexts: the ability to analyse ones mistakes calls for abstract notions and flexible (rather than simplistic) application of inference rules. On higher abstraction level the same general principle can be used in undergraduate logical education. Perhaps fixing a flawed argument or a faulty logical proof is not that different from mending a broken aeroplane built of plastic blocks.

TEACHING COMMISSION - PHILOSOPHY OF SCIENCE AND SCIENCE TEACHING: CONTRIBUTIONS FROM THE SPRINGER INTERNATIONAL HANDBOOK OF RESEARCH IN HPS AND SCIENCE TEACHING

Tuesday, August 4 • 18:00–19:00
Main Building, Room 13

The three-volume handbook was published by Springer in 2014 to mark the 25 years of publication of the journal *Science & Education: Contributions from the History, Philosophy and Sociology of Science.* It has 76 chapters, written by 125 authors from 30 countries. It deals with the contribution of HPS to theoretical, curricular and pedagogical issues in science and mathematics education. The 76 chapters are grouped in four sections: Pedagogical Studies (27), Theoretical Studies (32) National Studies (10), Biographical Studies (5). The extensive scope of the work is reflected in the Subject Index of 2,000 entries, the Name Index of 3,600 entries, and evidenced in its 10,200 references.

Each chapter sets the relevant literature in its historical context, and engages in an assessment of the strengths and weakness of the research addressed, and suggests potentially fruitful avenues of future research. The 25 chapters on 'Pedagogical Studies' provide comprehensive information on the classroom utility of HPS-informed approaches to teaching standard curriculum topics in physics, chemistry, biology, earth science, cosmology and mathematics.

The 35 chapters on 'Theoretical Studies' deal with Nature of Science (NOS) research, Cultural Studies in Science Education', Naturalism, Postmodernism, Religion, Inquiry, Laws and Explanations, Thought Experiments, Values, Critical Thinking, Scientific Literacy, Argumentation, and so on.

The five 'Biographical Studies' discuss Ernst Mach, Frederick W. Westaway, E.J. Holmyard, John Dewey and Joseph Schwab. These are the 'starting five' scholars who seriously engaged with the HPS of their time and used the engagement to inform their educational work. The eleven 'Regional Studies' chapters deal with the different trajectories of HPS-informed educational interventions in European, Asian, North America and Latin America, and the educational and political lessons learnt from these interventions.

The specific chapters being presented during the session will be:

Introduction and Overview of Handbook

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The HPS&ST Handbook project began in the middle of 2010 in discussions about how to celebrate the then-coming 20th anniversary of the founding of *Science & Education* journal. It was quickly obvious that a HPS and Science Teaching Handbook was the best and most useful way to mark the journal's publication milestone. Organised HPS&ST research began in the nineteenth century when Ernst Mach, the great German physicist, philosopher, historian and educator, founded in 1887 the world's first science education journal - *Zeitschrift für den Physikalischen und Chemischen Unterricht*. In the US, John Dewey in the 1920s explicitly addressed HPS&ST issues; these were later taken up in the 1950s and 1960s by, among others, James Conant, Gerald Holton, Stephen G. Brush, Leo Klopfer, Robert S. Cohen, Joseph Schwab and Arnold Arons. In the UK, HPS&ST issues were addressed from the 1920s in books and articles by Frederick Westaway, Eric Holmyard and James Partington; and subsequently by John Bradley, Joan Solomon and others. The same research questions have been investigated in Spanish, Portuguese, French, German and other traditions. To the present time *Science & Education* has published about 750 articles on HPS&ST themes; when other older journals are considered it is likely that 2-3,000 such articles have been published in just the Anglo tradition; to which can be added about 50 substantial books in the same tradition. All of this constitutes a lot of material to be covered and evaluated in the HPS&ST Handbook.

Contributors were invited on the basis of their competence in philosophical and historical scholarship, and their interest in theoretical and pedagogical problems of science and mathematics teaching. The expectation was that the handbook will demonstrate that HPS contributes significantly to the understanding and resolution of the numerous theoretical, curricular and pedagogical questions and problems that arise in science and mathematics education.

Generative Modelling in Physics and in Physics Education

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The extensive use of modelling in physics research has many implications on how it is used in physics education. An interesting case is the use of models in producing of new knowledge, which we here refer to as generative modelling. Generative modelling can serve as a cognitive tool bridging conceptual reality and real phenomena by mutually fitting of simulations and experiments. In this fitting process of fitting pursuing partial mimetic similarity in simulations and experiments acquires a central epistemological role. At the core of generative modelling is the creative use of theoretical and empirical elements of modelling as well as the explorative manipulation of real conditions to fit the models. We argue here that such modelling is also identifiable as authentic by the modelling practitioners themselves and that such a modelling approach supports constructively oriented and creative teaching solutions.

The History and Philosophy of Science and Science Teaching in Mexico

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Science is one of the main attributes of the contemporary world, and more than any other human activity, characterizes the current period from previous centuries. Great advances in the field of science and technology deeply influence natural and social processes. There has been a worldwide recognition of the role of science in modern societies, along with an urgent need to move towards more and better scientific education, particularly in developing countries. It becomes fundamental to modify the current education system regarding science and technology in countries like Mexico, where a cornerstone has been the inclusion of the reflections that historical and philosophical studies have produced in the last three decades. This article discusses the importance of recent history and philosophy of science studies for Science education in Mexico. The educational reforms in 1993 and 2006 acknowledge the advances in science teaching in basic education (elementary and junior high schools) as well as the inclusion of history and philosophy of science in official curricula.

HPS and Challenges of Multiculturalism in Science Education

Horsthemke Kai
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The biggest challenges facing science education have possibly been accessibility and relevance to its target audiences—challenges that have become more pronounced with the increasingly multicultural nature of teaching and learning environments. How does one render accessible a field of inquiry that has often been viewed as unnatural, difficult, or the intellectual playground of a select few? How does one instil in students a sense of relevance of science to their own lives and experiences, especially as science has its own culture with a special language, traditions, conventions, beliefs, and values; and if teaching and learning take place in a language and culture other than their home language and culture, and if it does not seem to engage, respect, and honour their prior knowledge, past experiences, and cultural perspectives? Recent decades have seen various approaches to multicultural education, the transformation of science education, and the learning of scientific knowledge, concepts, and practices in non-Western or indigenous societies. Chief among these approaches are the drives toward indigenisation, on the one hand, and toward internationalisation, on the other. After reflecting on lessons from Africa regarding the debates around Africanisation and globalisation, we examine the idea of *Transkulturalität* [transculturality]—as contrasted with multiculturality and interculturality.

SESSION OF THE COMMISSION ON TECHNOLOGY AND ENGINEERING SCIENCES: COMPLEX SOCIO-TECHNICAL SYSTEMS: FRAMES AND VALUES

Wednesday, August 5 • 14:30–16:30
Wednesday, August 5 • 17:00–18:30
Main Building, Auditorium II

Organized by:
the DLMPS commission on the Philosophy of Technology and Engineering Sciences.

Organizer:
Zwart Sjoerd
TU Delft, NETHERLAND
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Aim and Focus

The notion of socio-technical (ST) system was introduced by Eric Trist, Ken Bamforth and Fred Emery while working at the Tavistock Institute in London during the postwar reconstruction of the British coal mining industry. Their version of the term referred primarily to the interplay between human and technological factors in working environments within organizations. Besides this intra-organizational meaning of the term, a second connotation of ST-systems has emerged, primarily in engineering and managerial contexts. It refers to large, often infrastructural systems embedded in society as a whole such as the various worldwide transport systems (railway, traffic, aviation, and waterway), large energy distribution and storage grids, water supply, sewage networks and digital information distribution grids such as the internet. This societal, extra-organizational version of the ST-system notion is rooted within systems engineering, and users of the notion focus on the design and management of large and complex ST-systems (CST). CST-systems are different from engineering systems because, besides being larger and more complex, they are deeply intertwined with social reality made up by human individuals (in various roles such as multi-purposed users, operators, service men, inspectors, etc.), groups of human beings (such as action groups, organizations, legislators, governments etc.), and other more general structures of social reality (such as norms and value systems, legislation, regulations, monetary systems, states, etc.).

CST-systems are philosophically interesting and relevant for at least epistemological and practical reasons. First, the ways in which the physical, social and the normative levels of reality are interwoven within CST-systems makes the explanation and prediction of their features extremely complicated and sometimes even impossible. CST-systems exhibit deep uncertainty, feature emergent properties, and develop on various levels on different time scales. On a more general level we should ask what the most appropriate ways are to get a cognitive grip on CST-systems. Anti-naturalists should decide whether they should be studied using the methods of the natural or the human sciences, and if both, how these methods should be combined. Naturalists will not come very far by only applying various versions of the empirical circle to get practical knowledge about how CST-systems behave. Unfortunately, sociology does not offer much help. Until today sociologists have been reluctant to study thoroughly the influence of technology on social structures.

Next, the unpredictability of CST-systems poses difficult problems for those who want to optimize, redesign and design them. Unfortunately, CST-systems do not let themselves to be designed and developed as refrigerators or cars. Simple models of instrumental design rationality fall hopelessly short for their development. To begin with, CST-systems are almost never designed from scratch. Many elements of the future CST- system often already existed before the CST-system has come into being and should be rearranged or adapted within the redesign process. Moreover the design requirements are not given at the start of the project but develop all along the way during the redesign. The goals are adapted to the means available and CST-systems have so many different kinds of roles and stakeholders that many of their goals may even be mutually exclusive.

Finally, many important societal problems are linked to CST-systems. Questions about information and transportation infrastructures and their security are often closely related to philosophical discussions about global justice; climate change, energy and mobility; sustainability and the environment. Moreover, these problems are here to stay—and are even likely to increase their impact in the future. In this symposium we focus on different frames on CST-systems and their related values. In the first four presentations we address the questions of how to model and conceptualize CST-systems and the various roles that they involve; after that we will turn to the practical and normative side of CST-systems.

In the first contribution *Nicola Guarino* asserts that an agent assumes an assigned role if she is supposed to fit a predefined behavioral pattern imposed to her (e.g., an employee); a non-assigned role is bestowed on an agent if a certain person just happens to fit a certain pattern of social expectations emerging from the interaction (e.g., a stakeholder). This difference in the direction of fit [Anscombe, Searle] has considerable implications for ST-system classifications. Next *Stefano Borgo* invites us to consider a context of CST-systems to be an ontologically mixed object that comprises two types of entities: (1) a description that lists the relevant entities and gives their relationships and roles (the conceptual framework) and (2) the physical, technical, social and information entities that actually instantiate, perhaps just in part, this description (the actual instantiation of this framework). He will discuss how the two-component interaction helps to model, analyze and compare CST-systems. After that, *Daniele Porello* and *Roberta Ferrario* will develop an ontological entanglement model of the normative, social and technical information from a sociotechnical stance. They will characterize legitimate sociotechnical ascriptions to several entity types within their ontology. Then, during the fourth and final contribution to the framing part, *Maarten Franssen* will explicate the complexity of CST-systems, using the multitude of the perspectives, actions, and goals within such a system and the question of which agent uses what means to achieve what end within the system. He will offer conceptual tools for dealing with this complexity, presumed to be available in engineering design. Franssen will go back to the barest outline of CST-systems, focusing on a few toy situations, such as the regulation of traffic on a crossroad through traffic lights and a taxi company offering taxi cabs for hire. This will end the part on the conceptualizing part of the meeting.

After the refreshments we will turn to normative issues relating to the design of, and autonomy within CST-systems. First Rafaela Hillebrand will discuss CST-system design for values and the role of procedural values in institutional design. She contends that CST-systems require an encompassing concept of value-sensitive design that has to look both at technology and the accompanying institutions. She illustrates her case by wind parks in the North Sea, where adequately designed institutions are necessary to ensure certain values, such as network stability, which are commonly perceived as "technological." What is perhaps even more important, she claims that certain institutions are needed to incorporate procedural values, e.g., by creating the institutional framework for stakeholder participation. Next, Sabine Thürmel focuses on participation in autonomous systems. She argues that in current CST-systems novel varieties of interplay between humans, robots and software agents are on the rise. Due to these developments we may speak of a participatory turn when assessing the current division of labor between humans and nonhumans. While the autonomy of the technical agents and their abilities increase over time human autonomy may be decreasing. Thürmel argues that to balance human and technical autonomy, we need a responsible innovation process that guides the modeling and employment of ST-systems.

Short abstracts of the planned talks

The Crucial Role of Stakeholders in CST- Systems

Guarino Nicola

A proper understanding of roles is of fundamental importance in ST-systems, where people, artifacts, organizations and norms interact one each other in different ways. Indeed, the way each of these components behaves in the system depends on the *role* it plays, i.e., on the specific relationship between the component and the system. So, a formal characterization of such different roles and their interplays can contribute to understand the *nature and structure* of ST-systems, i.e., their *ontology*.

In particular, most of the roles occurring in ST-systems are social roles, in the sense that bearing such roles presupposes some kind of intentionality external to the bearer: Being an *employee* or a *stakeholder* of an enterprise are typical prototypes of social roles.

There is however a crucial difference within social roles, which is very relevant to understand the nature of ST-systems. This is the difference between *assigned* and *non-assigned* roles. The *employee* role is assigned to a certain person, so that she is supposed to fit a pre-defined behavioral pattern *imposed* to her; the *stakeholder* role is not *assigned*, but just *recognized*, in the sense that a certain person *just happens* to fit a certain pattern of social expectations emerging from the interaction. So, the *direction of fit* [Anscombe, Searle] is different in the two cases. As a consequence, there is a striking difference between the two kinds of role, with very practical implications for ST-systems: only for assigned roles, and not for non-assigned ones, the bearer can be *replaced*: you can replace an employee, but you can't replace a stakeholder. Thanks to this formal difference between roles, we can give the following short answers to some of the questions raised in this Symposium:

1. An ST-system does necessarily include assigned roles (with both human and non-human bearers).

2. It is exactly the presence of non-assigned roles that distinguishes CST- from ST-systems (and makes it impossible to fully design them).

Context as a modelling device for CST systems

Borgo Stefano
CNR (National Council of Research), ITALY

Context, i.e. the set of facts or circumstances that surround a situation or event (WordNet) or the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood (Oxford Dictionary), is one of those notions that are hard to avoid, even in scientific talk, when discussing complex entities. Unfortunately, the notion of context itself is unclear and, at the same time, very broad in meaning: it is hard to characterize what it means or the boundaries of its application. Multifarious terms like 'circumstances', 'surrounding' and 'setting' are widely used across dictionaries, research papers and other information resources when trying to 'explain' contexts.

Complex social-technical (CTS) systems cannot be fully analyzed in a linear way and people resort to *contextual talk* to introduce and discuss aspects of their structures, behaviors, multiplicity of roles, functions etc. To take advantage of this capacity, we aim to ontologically characterize contexts and to indicate how to formalize them in logical terms (so to make them part of a formal machinery) for this kind of use in CST-systems. Of course, even when addressing CST-systems one can easily build discourse environments[1] that reintroduce the variety of possible meanings of `context'. Nonetheless, by seeing a CST-system as a study subject and by just using contexts for its analysis, we can successfully anchor the notion.

We propose to see a context as an ontologically mixed object that comprises two types of entities (only the first of these is actually mandatory): a description or information entity that lists what entities are on focus and gives their relationships and roles (context as a conceptual framework to model expressions like 'in the transportation context', 'in the context of an exam'), and the physical, technical, social, information entities that actually instantiate, perhaps just in part, the description (context as a situated framework to model, e.g., 'in the context of the Italian transportation system', 'in the context of last week exam for class P101'). We will present how the two components interact from the (applied) ontological perspective, the potentiality of this definition and examples of how it helps to homogeneously model, analyze and compare general and specific cases of CST-systems.

[1] The terms 'context' and 'environment' are strongly related: informally speaking, the latter is a context which is maximal wrt some dimension or property.

The Socio-Technical Stance

Porello Daniele
CNR (National Council of Research), ITALY
Ferrario Roberta
Italian National Research Council, ITALY

In this work, we apply ontological analysis in order to answer the question: "what kind of entity can be categorized as a socio-technical system (STS)?" In particular, we will discuss the identification problems for STSs and try to understand whether and, in case, how their boundaries can be set out. The adjectives "socio-technical" or "socio-material" have been applied to a wide spectrum of very different things: organizations, facilities, institutions, even general social relations between individuals. We will argue that, rather than providing necessary and sufficient conditions for classifying something as a STS, it is more informative to investigate and model felicitous ascriptions of socio-materiality or socio-technicality to organizations, institutions, etc. For instance, an airport can be described as a STS but also as a complex technical artefact, a geographical area, a public or private company, an organization, a group of individuals. We claim that all these heterogeneous layers are not mutually exclusive, they are rather co-present in such a complex system as an airport and must be taken into account in the analysis and in the modeling. None of these layers (not even their combination) is essentially a socio-technical system; the main claim of this work is that socio-technicality is something that can just be ascribed, when we analyze a complex system at a certain level of abstraction, by applying an analytical attitude that we would like to call "socio-technical stance". Obviously, socio-technicality cannot be applied to whatsoever, so the point is then to understand when we can legitimately ascribe it and what are the consequences of such an ascription. We focus in particular on an element that seems to be specific of STS: the entanglement of layers of heterogeneous information (for instance visual, technical, normative, social...). We will show that the entanglement is non-reducible in the relevant cases of STS. We will develop an ontological model of the entanglement of normative/social/technical information and we will define legitimate ascription of socio-technicality to a number of types of entities in our ontology.

Sociotechnical systems and their users

Franssen Maarten

Although there is no sharp, broadly accepted definition of a sociotechnical system, the term roughly indicates a complex entity consisting partly of technical devices and partly of people, in various roles, which has a particular function, i.e. through which some purpose is or some purposes are achieved. Typical real-life examples are large infrastructures (e.g. for energy transportation and distribution, transportation, or communication) or production companies (e.g. mining or manufacture). Such systems figure in an instrumental action context: there are users who realize goals through some form of use. In the case of sociotechnical systems, however, we are dealing with multiple users, multiple forms of use and multiple goals, and accordingly multiple perspectives on how well or poorly the system is functioning.

The concept of using something for some purpose is typically analysed from a single point of view: someone is, say, using a hammer to drive a nail through some pieces of wood. Now suppose this someone asks another person to hold a piece of wood stable during the hammering. Right away we have two perspectives, two actions and two sets of goals, and the question of who uses what to achieve what no longer has an obvious answer; it has to address a complexity completely absent from the initial situation of the lone hammerer.

This talk will explicate that complexity for sociotechnical systems and offer conceptual tools for dealing with it, in a descriptive sense presumed to be available in engineering design to account for the proper functioning of artifactual systems. It will do so by focusing on a few toy situations, such as the regulation of traffic on a crossroad through traffic lights or a taxi company offering taxi cabs for hire.

Design for Values and CST-Systems. The Role of Procedural Values and Institutional Design

Hillebrand Rafaela

Today ethics of engineering and technology does not contend itself with its original role as a retrospective technology assessment; rather it increasingly aims to incorporate ethical and societal values already in early design phases of new technologies. Here particularly the design-for-value approaches such as value-sensitive-design or design-for-sustainability have gained prominence. While these have been successfully applied to, for example, ICT technologies, we contend in this paper that a design-or-value approach for CST-systems requires a broader perspective than only on the design of the technological components. We argue for an encompassing concept of value-sensitive design that necessitates looking not only at the technology itself and its impacts, but also at the accompanying institutions.

In developing our argument we zoom in on energy systems with components as diverse as power plants, electrical grid(s), storage facilities as well as the users and other stakeholders. More specifically, we take the current development of offshore wind parks in the North Sea (including the accompanying changes in grid, storage etc.) as a study case. It is shown that in the case of CST-systems adequately designed institutions are necessary to ensure certain values that, such as network stability, are commonly perceived as "technological" values. Moreover, and maybe more importantly, certain institutions are needed to incorporate procedural values, e.g. by creating the institutional framework for stakeholder participation. We present a blueprint for such an encompassing design for values approach to a combined technological and institutional design of offshore wind parks in the North Sea, which aims to provide insights into a design-for-values approach to energy systems and CST-systems more generally.

Participation in Autonomous Systems

Thürmel Sabine

In current socio-technical systems novel varieties of interplay between humans, robots and software agents are on the rise: Software agents and robots may support humans, act on their behalf or even collaborate with them. Both regulation and control can be delegated to technical agents. Smart energy or Smart health systems are a case in point. In many distributed problem solving approaches humans and technical actors have become interaction partners. Emergency response systems based on multi-agent systems exemplify this development. Due to these developments we may speak of a participatory turn when assessing the current division of labor between humans and nonhumans. New capabilities in technical agents may emerge over time on the individual level due to machine learning algorithms. Even new cultural practices and novel policies may emerge: Big Data approaches may be employed for the optimization of individual behavior based on Big Personal Data or for the optimization of the behavior of a social system relying on Big Social Data. Autoadaption may occur on the individual and on the system level. Such social engineering is used in proactive health systems nudging the human users to (social) conformity with the predefined goals. While the autonomy of the technical agents and their abilities increase over time human autonomy seems to be decreasing. The governance embedded in these systems restricts the autonomy of the human participants and imposes an opaque guidance. In order to balance human and technical autonomy a responsible innovation process guiding the modelling and employment of such systems is essential.

Preliminary Program

The Crucial Role of Stakeholders in CST- Systems

Guarino Nicola
e-mail: nicolguar@gmail.com

Context as a modelling device for CST systems

Borgo Stefano
e-mail: stefano.borgo@cnr.it

The Socio-Technical Stance

Porello Daniele
Ferrario Roberta
e-mail: danieleporello@gmail.com]

Sociotechnical systems and their users

Franssen Maarten
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-- Break --

Design for Values and CST-Systems. The Role of Procedural Values and Institutional Design

Hillebrand Rafaela
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Participation in Autonomous Systems

Thürmel Sabine
e-mail: Sabine.Thuermel@gmx.net

ARABIC LOGIC COMMISSION

Friday, August 7 • 11:00–13:00
Main Building, Room 7

Could Ibn Sina's logic be undecidable?

Mohammad Maarefi
IPM, Tehran, IRAN
11.00

Ibn Sina (Avicenna) started from Aristotle's non-modal syllogistic, which is encodable as a fragment of monadic predicate logic and hence is decidable. But Avicenna introduced several new logics, some of which involve relations between things and times, with multiple quantification. We are still identifying his logics in terms of modern logic. All the parts that have been unambiguously identified so far are decidable. But his writings contain suggestions for other extensions of logic where decidability is not so clear, and we are not in a position to say that all his logics have a property that implies decidability (for example needing just two variables). In this talk we approach him from the opposite direction, describing one way in which his temporal logic could lead naturally to undecidability.

Al-ʿAllāma al-Ḥillī and the early reception of the Shamsiyya

Street Tony
Faculty of Divinity, University of Cambridge, UNITED KINGDOM
11.40

Ḥillī wrote the first commentary on Katibi's Shamsiyya, and it reveals how often Katibi had silently adopted a disputed position in writing his textbook. Placing the Shamsiyya and Ḥillī's commentary in historical context, we can discern something of the nature of the logical discussion underway in the thirteenth century. This paper illustrates one method for reconstructing these discussions.

TaḤrīf in Medieval Arabic and Persian Logic Texts: A threat to Compositionality?

Lameer Joep
Membre Associé, Laboratoire SPHERE, Université Paris Diderot - Paris 7, FRANCE
12.20

In a recent publication in The Oxford Handbook of Compositionality,* Wilfrid Hodges introduces the Arabic concept of taḥrīf ('alteration', 'distortion', 'corruption'). Avicenna (d. 428 AH /1037 CE), to whom Hodges refers, says actually very little about the matter. In logic, taḥrif appears to be mostly post-Avicennan and to have two main areas of application: sophistics and the quantification judgments in the context of Aristotle's de Interpretatione. In this lecture I shall give a brief overview of views on taḥrīf among the major representatives of the post-Avicennan logical tradition in Arabic and Persian. Special attention will be given to taḥrīf's compatibility with the principle of compositionality as implicit in the Peripatetic tradition.

* Wilfrid Hodges, "Formalizing the relationship between meaning and syntax", in: Wolfram Hinzen, Edouard Machery, and Markus Werning (eds.), The Oxford Handbook of Compositionality (Oxford University Press, Oxford 2012), 245-261.

SESSION OF HAPOC: COMPUTATIONS, PROOFS AND MODELS

Friday, August 7 • 11:00–13:30 (Session I)
Friday, August 7 • 14:30–16:30 (Session II)
Friday, August 7 • 17:00–19:00 (Session III)
Main Building, Auditorium IV

Symposium organized by the DHST commission for the History and Philosophy of Computing

In the late 40s, when the first computers were built and used, programming was a tedious and laborious work, an entirely different practice than what we now consider the art and science of programming. The programmability of these computers, combined with their electronic speed, as von Neumann stated it, made the stored-programming concept natural, but also necessitated the integration of logic into the problem of programming. Since then, computer science and engineering have become more and more intertwined with logic. Existing models of computability have been rediscovered and adapted; programming semantics rooted in logic have been developed; the use of logic to model automatic reasoning processes has become a research field in itself. These different interactions between logic, formalization and computer science have helped shaping the field of computer science itself and changed at least in part the way we understand logical reasoning. The aim of this symposium is to explore these continuing interactions, in order to gain a deeper understanding on the nature of computer science and the contributions of logic to it.

The symposium is organized by the DHST commission for the History and Phiosophy of Computing. Since the first HaPoC conference in 2011, the community of people interested in HaPoC is thriving and a large number of different events has been organized. The general spirit of these events is interdisciplinarity and openness towards different fields relevant to HaPoC, guided by a quote by Mike Mahoney that the computer is not one thing but many things and that the same holds true of computing. We were and are strongly convinced that such trans- and interdisciplinarity is necessary if one wants to reflect on a discipline such as computer science with its multidimensional nature. The current symposium will be organized in a similar manner and invites researchers coming from a diversity of backgrounds, including historians, philosophers and computer scientists who want to engage with topics relevant to the history and philosophy of computing

Programme:

Session 1:

Putting Mathematics into the Computer: Implementation and Epistemology in Early Automated Logic
Stephanie Dick
Harvard University, UNITED STATES

Defining the semantics of proof evidence
Miller Dale
Inria/Saclay, FRANCE
Lix

Formalism and Computations
Koepke Peter
University of Bonn, GERMANY

Session 2:

The Church-Turing Theses
Shagrir Oron
University of Jerusalem, ISRAEL

TBA
Symons John
University of Kansas, UNITED STATES

Competing Claims to Computing as a Discipline
Tedre Matti
Stockholm University, SWEDEN

COMMISSION SESSIONS

Session 3:

Using History to Make Software More Tangible
Daylight Edgar
Universiteit Utrecht, NETHERLANDS

How do we know that a statement true in Computer Science?
Dowek Gilles
Inria/Deducteam, FRANCE
Mooc Lab, FRANCE

Discussion

INTERNATIONAL UNION OF HISTORY AND PHILOSOPHY OF SCIENCE (IUHPS) JOINT COMISSION SESSION: HISTORY OF SCIENCE, INTEGRATED HISTORY AND PHILOSOPHY OF SCIENCE

Joint Commision Invited Lecture: International Union of History and Philosophy of Science (IUHPS)

Saturday, August 8 • 10:00–11:00
Main Building, Room 5

Prospects for an Integrated History and Philosophy of Composition

Chang Hasok
University of Cambridge, UNITED KINGDOM

I propose a new line of argument against metaphysical reductionism. Following John Dupré, Nancy Cartwright and others, my approach is based on a commitment to respect the best scientific practices and their outcomes while not renouncing philosophical judgment. I focus on the practices of decomposition in chemistry and physics, in order to questions the common assumption that everything can be smashed up into smaller and smaller units, down to elementary particles.

The practice of decomposing matter into its building blocks began in analytical chemistry centuries ago. But a careful look at the history of chemistry reveals that most of the useful analytical techniques did not involve simple decompositions. In the reactions in which molecules were somewhat cleanly dissociated into smaller units, those units most often turned out not to be atoms (as in the dissociation of H_2O into H^+ and OH^-, or into H_2 and O_2), since the stable units were often not atomic (e.g., H^+ and H_2, not H). In the early days of chemical analysis, there were also worries that the processes of alleged decomposition might be altering the substances being analyzed or even creating new ones.

Interestingly, these worries are reproduced and amplified when we consider the theoretical and experimental practices of modern nuclear and particle physics. "Atom-smashing" has never been Lego-like disassembly: when atomic nuclei are broken up, energy is almost always added or subtracted, and according to modern physics energy is a form of matter. Generally, experiments in high-energy physics paint a picture that does not support the naïve philosophical view of reductive levels (as stated by Paul Oppenheim and Hilary Putnam), according to which atoms are made up of elementary particles, which are unchangeable building-blocks. When two protons collide into each other in a particle accelerator, a whole host of other particles are created: should we say that a proton already contained these particles? And pair-creation and pair-annihilation should not lead us to conclude that a pair of photons consist of an electron and a positron, or vice versa. More generally, smashed-up pieces may not pre-exist in the whole. The ontology of virtual particles and vacuum fluctuations complicate the picture even further. Geoffrey Chew's "bootstrapping" view of elementary particles may be worth revisiting, after all.

In summary, attention to the actual practices of the physical sciences reveals that there has never been unequivocal scientific warrant for metaphysical reductionism as it is commonly conceived. If the source of metaphysical reductionism is not science, then what is it, and is it a trustworthy source? I will conclude with some methdological reflections concerning the prospects for bringing to the study of ontology the perspective and methods of integrated history and philosophy of science.

JOINT COMMISSION: CONTRIBUTED PAPERS 1

Friday, August 7 • 14:30–16:30
Main Building, Room 8

Descartes and mathesis universalis - the rise of the modern algebra

Joutsi Jaakko
Department of Social Sciences and Philosophy, University of Jyväskylä, Palokka, SUOMI

My paper of the history and philosophy of mathematics is aimed to create the clear picture about the radical changes that happened in 17th century mathematics: the gap between the ancient geometry and modern algebra is wide, but how exactly Descartes was led to the algebraic approach in his mathematical work Geometry? What were the philosophical thoughts behind the ancient Greek and early modern era?

This paper reveals that although Descartes did not value Euclid and his followers, Descartes believed that other ancient mathematics, like Diophantus and Pappus had the secret method, mathesis universalis they kept hidden. Descartes also claims that the rise of the early-modern algebra is the revival of this ancient method.

This research presents the model about this ancient method that might have been in Descartes' mind while developing his new mathematics. My main claim is that tor Descartes axiomatization of geometry itself is only a trickery that is meant to hide the true nature of mathesis universalis. In modern philosophy it is often suggested that Descartes was a precursor to the Newton's axiomatic method, but in my paper I prove this is a misunderstanding.

A note on the role of physical reasoning in Ptolemy's mathematical astronomy

Itokazu Anastasia
Centro de Ciências Naturais e Humanas, Universidade Federal do ABC, Santo André, BRAZIL

One of the main criticisms directed by Copernicus against Ptolemaic geocentric planetary theory addresses the latter's lack of unity, as expressed by the popular monster metaphor. However, although Copernicanism allowed a greater unification of astronomical hypotheses, most notably in the explanations of planetary retrograde motions, one might still ask if such criticism is fair within the framework of the Almagest. The present paper aims to provide some insight into how Ptolemy regarded the issue of the diversity of hypotheses in astronomy. The subject integrates a larger discussion about the epistemological status of mathematical hypotheses at Book IX of the Almagest, which is understandably rich in meta theoretical content since it introduces Ptolemy's most original work, the planetary models with an equant circle. The core of the argument consists in the assertion that circular motion is preserved for all celestial phenomena, without exception, in spite of the fact that these phenomena are not all alike. This solution provides a key for understanding the role of celestial physics in Ptolemy's mathematical astronomy, and challenges Pierre Duhem's instrumentalist interpretation.

Lyons, Kepler, and the commitments of deployment realism

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Timothy Lyons argues that Psillos' "deployment realism" should be committed to the truth of all the components actually employed in reaching successful novel predictions. He then explains that Kepler made novel predictions (e.g., that the Sun spins, that a planet's speed is highest at its perihelion and lowest at its aphelion, etc.) reasoning from the false assumptions that (1) the planets tend to rest, but the Sun rotates, and transmits this rotation to them through rays whose force decreases with the distance. This, concludes Lyons, refutes deployment realism (T. Lyons, "Scientific Realism and the Stratagema de Divide et Impera", BJPS 2006). I reply that in abduction we should postulate only the weakest cause sufficient to explain the effects. Equally, in explaining a novel prediction, we should assume the truth of only the essential components, i.e. the weakest ones sufficient to reach the prediction. Kepler abductively inferred (1) from facts he knew: (2) the planets move around the Sun on the same plane and in the same wise, and their velocities are in the inverse order as their distances from the Sun. This could suggest that the solar system rotates as a coherent (but viscous) disk, whose periphery is slower than the centre. Of course (1) was unnecessarily strong as an explanation of (2), but it had a weaker core, better supported by (2), and true: (3) the solar system moves around (a point close to) the centre of the Sun, due to something which is inversely related to the distance from it. Since Kepler's new predictions could already be derived from (3), (2) was not essential to them, while (3) was essential but true, and this confirms deployment realism.

D'Alembert's doubts

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Newton discussed in the 'Optical lectures' (1670-1672) two potential laws enabling to explain the phenomenon of dispersion of white light through a prism. The first law, quadratic, had been elaborated from considerations on speed of lighting corpuscles in the frame of gravitation theory. The other law, formulated by elaborating a quantitative colors scale, had a linear expression. On a quantitative point of view, these two laws did not differ for the results they led to, in any case insufficiently so the differences are detectable with the methods of measure that Newton had at his disposal. It is only much later, when he had elaborated his theory of light that Newton, based on the analogy with the results of musical harmony, finally adopted the linear law of dispersion. He decided on the impossibility to be able to build refractor achromatic systems. In 1747, Euler criticized the Newton's point of view and proposed a logarithmic-type law to explain the phenomenon of dispersion. Based on these ideas, the Englishman John Dollond managed to build achromatic systems and published his discovery in 1758. D'Alembert, in the 20 and 49 'Mémoires' of 'Opuscules mathématiques', dedicated to achromatic lenses, discussed the matter and expressed doubts about theories respectively exposed by Newton and Euler. He raised also the epistemological issues, notably linked to different possible choices of a law and its necessary or contingent nature that we propose to discuss.

JOINT COMMISSION: CONTRIBUTED PAPERS 2

Friday, August 7 • 17:00–19:00
Main Building, Room 8

The (non-Newtonian) conception of time in Hume and Einstein: Similarities and Differences

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Einstein's overt acknowledgement to "Hume, whose Treatise of Human Nature I studied with passion and admiration shortly before discovering the [special] theory of relativity," has drawn interest among contemporary historians and philosophers of physics. John D. Norton has provided a possible reading on the constructive connection of Hume to Einstein. His main thesis is that Einstein was most influenced by the way Hume saw ideas and concepts to be grounded in sense impressions. If the concept of simultaneity is grounded in sensible impressions, such as in visual sensations of immediate light flashes in two mirrors, it follows (given the two postulates of STR) that different inertial reference frames can observe the timely order of two non-causally related spatially distant events, the two light flashes, in different order. The revision of the concept of simultaneity defied the absolute Newtonian character of time. In this paper, I will take a closer look at Hume's and Einstein's conceptions of time. First I argue that there are important similarities between their conceptions. Both Hume and Einstein understand time in relationist terms: the idea or concept of time refers to objects. There is no meaning in speaking of Newtonian "absolute duration," or "time in and of itself and of its own nature, without reference to anything external." Duration and simultaneity are not absolute, since they are dependent on the observer/reference-object relation. However, I argue that in Hume's philosophy of time the relation between an observer and a reference object is not the same as in Einstein's STR. To Einstein (in STR), time is an event which can be expressed in mathematical terms by the Lorentz transformation equations. Hume does not understand time as an event, but rather as an abstract idea of succession or change which is caused by discretely disposed indivisible moments.

What happened to phlogiston? Reconsidering the Chemical Revolution

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Major theory-shifts in science, such as the transition in the late 18th century from a phlogiston-based chemistry to something more like modern chemistry, raise a number of philosophical questions. Among these are the question of accounting for the shift, and whether it can be regarded as rational. Another is whether the discarded theoretical commitments provide fodder for a pessimistic meta-induction. This talk looks at the so- called Chemical Revolution with these questions in mind. The shift involved a shift in multiple theoretical presuppositions, in commitments about the basic substances that make up the world, and also a shift in methodology. Philosophical attempts to account for the shift have tended to be holistic. However, the components are logically independent, and it is possible to accept certain aspects of Lavoisier's novel approach to chemistry while rejecting others. This is key to understanding the shift. At any given point in science, certain propositions are more firmly established on the basis of evidence, others, more speculative. Moreover, such judgments need not be made only in hindsight; they are present in attitudes of scientists at the time. I will argue that Lavoisier provided convincing evidence that (contrary to accepted versions of phlogiston theory), in combustion a component of the air combines with the combustible material, and this is what Priestley had referred to as "dephlogisticated air" and Lavoisier renamed "oxygen." One can accept this proposition without accepting all of Lavoisier's theoretical edifice, and, indeed, without accepting the whole of Lavoisier's theory of combustion. However, acceptance of this proposition eventually led to abandonment of phlogiston. Implications for scientific realism will be drawn. Of the entities posited by a mature science, not all are equal; some are more firmly established on the basis of evidence, others, more speculative. I will argue that phlogiston was always somewhat speculative.

On Richard Cantillon, Or How the Economic Science Has Acquired Its Method and Methodology

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William S. Jevons called Cantillon's Essai sur la Nature du Commerce én Général "the Cradle of Political Economy". Although Schumpeter rejected this metaphor, he did recognize that the unique Cantillon's feature is his systematic method of investigation and presentation of economic reality. It is now acknowledged that Cantillon's strong influence goes through the Physiocrats to Adam Smith. This paper argues that the impact of Cantillon's Essai was not confined to theory: it provided a template for economic thinking for many generations of economists and presented the first conscious attempt to formulate methodological principles of the new science. The paper is intended to systematize both declared and actual methodology of Richard Cantillon, his critical remarks addressed to earlier authors, the ways how he isolated economic phenomena and structured economic realm. Cantillon widely used thought experiments and verbal modeling, but never forgot to verify them with actual, or historical facts, or numerical examples. He built deterministic models, but did not fail to remind readers of uncertainties of the real world preventing 'exact calculations'. He preferred 'to be nearer enough to the truth' rather than to seek for 'not very necessary exactitude'. He was consciously abstract in order to come closer to understanding concrete phenomena. He appealed to the ideal of value-free science, and violated it, as did later plenty of his successors. It is suggested that Cantillon's most durable contribution to economic science comes from ontological assumptions underlying his theorizing. These were borrowed by later theoreticians to become essential, taken for granted preconceptions of economic profession. Some of them were dropped by the successors and later reintroduced into economic theory without important insights implicit in Cantillon's vision. It refers primarily to uncertainty which was incorporated into Cantillon's ontology through entrepreneurial activities, later disappeared from economic theories for about two centuries.

Charles Darwin and Sir John F. W. Herschel: Nineteenth-Century Science and its Methodology

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James Lennox has argued that if it is indeed possible to say that Darwin was an innovator in his field, "it is as a philosopher and methodologist." Indeed, there is a bewildering variety of claims connecting Darwin to nineteenth-century philosophy of science – including to Herschel, Whewell, Lyell, German Romanticism, Comte, and others. I argue here that, whatever is to be made of the other connections, Herschel's influence on Darwin is undeniable. The form of this influence, however, is often misunderstood. While Jon Hodge has worked out a careful interpretation of both Darwin and Herschel over a series of some half-dozen articles, this interpretation misreads Herschel's use of the vera causa principle, as well as his discussion of the role of hypotheses in scientific theory construction. Darwin learned from Herschel precisely the way in which one should frame a scientific argument – first by proposing a speculative hypothesis, grounded on an extensive analogical basis, then by demonstrating the adequacy of that hypothesis to produce the desired effect, and lastly its ability to account for a wide variety of phenomena which it was not originally proposed to explain. This new reading of Darwin's relationship to Herschel adds to the usual collection of sources Herschel's own marginalia to Darwin's Origin, from the archives at the University of Texas. It goes farthest, I argue, toward explaining why Darwin wrote the Origin in the way that he did, as well as why Herschel's criticism of his theory as "the law of higgeldy-piggeldy" would have stung Darwin so deeply.

JOINT COMMISSION: CONTRIBUTED PAPERS 3

Saturday, August 8 • 13:30–15:30
Main Building, Room 14

Models of Data, Theoretical Models and Structural Relationships in the History of Genetics

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According to the most popular version of the history of genetics – the so-called "traditional account" (Olby 1979), "orthodox image" (Bowler 1989), or "official story" (Lorenzano 2013) –, "classical" ("formal" or "Mendelian") genetics is a discipline whose history had happened in a continuous, accumulative and linear way. Since its assumed origins with the work of Mendel, through the work of the so-called "rediscoverers" de Vries, Correns and Tschermak, and of the English Mendelian Bateson to the work of Morgan and his school, genetics had been passed without frictions. So much the problems and intentions of research of the aforementioned investigators as well as, in a higher or lower degree, the meaning of the fundamental concepts used by them and the conceptual systems out of which the concepts get their meanings, are assumed to be constant. Since more than thirty years the above interpretation is seriously discussed and questioned by historians of genetics, so that at the present time we have a wide variety of positions with respect to it from the suggestion of modification of some particular points to the whole revision of the traditional historiographic account. Among the historians of genetics there are those who emphasize the existent discontinuities and ruptures between (at least some of) the developments carried out by the abovementioned researchers. The aim of this communication is to present an analysis of the history of genetics in terms of structural relationships between the models of data and theoretical models of the different successive proposals, in a way that would be possible to capture and to make precise the idea that between them there are discontinuities and ruptures – of the kind pointed out by the opponents of the "traditional account" – as well as continuities – which allows to understand the existence of such an account –.

What did the "Rediscoverers" discover in 1900? A New Analysis of the Birth of Genetics

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Traditionally, historians regard 1900 as the year of the birth of genetics when de Vries, Correns, Tschermak independently rediscovered Mendel's laws of heredity. However such a rediscovery story was challenged seriously. Many historians (e.g. Hans-Jorg Rheinberger 1995, Roberts 1929) have shown that all the three rediscoverers have read Mendel's paper before the completion of their experiments, so they in fact did not INDEPENDENTLY rediscover Mendelism. On the other hand, it is very dubious what the rediscoverers really discovered in 1900. Recently more and more historians realize that Mendel's work was in fact about development rather than heredity. If so, it is problematic to maintain that the rediscoverers rediscovered the laws of heredity, given that Mendel's laws are not about heredity. In this paper, I aim to propose a new way to analyse and understand the birth of genetics. Firstly, I shall propose and defend a new interpretation of the origin of genetics (1865-1900) by arguing that 1) Mendel's work was about development; 2) the rediscoverers' work were about heredity. Secondly, I shall redefine the Kuhnian notion "exemplar", and propose a new philosophical analysis of the birth of genetics in 1900 in terms of exemplar to interpret the change from Mendel to the rediscoverers. Thirdly, I shall show why my exemplar-based approach is better than the theory-based approach in analysing the origin of genetics.

What do Wound Repair, Chimeras, and Embryonic Stem Cells Have in Common?

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Bioethicists might see all three topics as socially fraught, raising ethical questions about the sanctity of individual life. Historians might provide contextualization, drawing stories from archival and published records. Philosophers are likely to draw on theoretical interpretations, perhaps pointing also to underlying epistemological assumptions. Biologists, meanwhile, will keep looking for more data and interpretive frameworks.

This talk will look at these three 20th century cases. Inspired by World War II, Ross Harrison wounded frog embryos to determine whether cells would add new cells or would re-differentiate as different kinds of cells. How much could one learn about normal development from abnormal wound repair? In the 1960s, Beatrice Mintz stuck together embryos from different mouse varieties to make chimeras, and more recent work on genetic chimeras shows how tremendously adaptive a developing embryo can be when taken apart and put back together in different combinations. This work has challenged simplistic assumptions about what it is possible to do and to know about individual organisms and their parts. In 1998, James Thompson cultured human embryonic stem cells, following previous work on mouse cell lines. His cultured cells seemed to be immortal and to promise tremendous capacity for regenerative medicine, even though they were completely artificial and do not exist in nature.

In each case, the researchers assumed that producing artificial results would prove epistemologically rich, leading to understanding of normal development. In each case, the researcher was fascinated by what makes a whole organism and how the parts relate to that whole. The historical details about the biology inform philosophical reflection about how we understand, and how we should study, life. Drawing on historical, philosophical, and biological perspectives together give a much richer picture of how the science works and what these cases have in common.

Karl Pearson's phenomenalism : Its impact on the theories of heredity and evolution in the early 1900s

Gayon Jean
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Karl Pearson (1857-1936), the most theoretically inclined among the British biometricians, also wrote a number of philosophical texts, The Grammar of Science (1892, and a considerably revised edition in 1900). Together with the Ernst Mach's writings, Pearson's Grammar of Science, was a major source for the descriptive or phenomenalist conception of science. The purpose of the present talk will be to articulate Pearson's scientific philosophy with biometrical work on heredity and evolution. The first section will summarize Pearson's philosophy of science, which explicitly characterizes science as "a description and conceptual classification of our perceptions", and a kind of knowledge which, strictly speaking, explains nothing. I will relate this thesis, commonly associated with Mach, to the philosophical thoughts of William Rankin, the Scottish philosopher who had previously opposed (1855) "abstract" and conjectural" theories. The second section of the paper will explain the chronology of Pearson's involvement in statistical biology, and the role played by his philosophical conceptions in this new scientific field. The cases of heredity and evolution should be distinguished, because these two fields were in a different epistemological situation just before 1900. Darwin's theory of evolution offered an example of genuinely explanatory science, structured according to the Newtonian ideal of vera causa — or rather the notion of vera causa elaborated by several 19th Cy British philosophers and physicists. At the same time, the theory of heredity was a rather speculative field, consisting of a number of rival hypotheses about the physiological basis of inheritance; it also included Galton's statistical theory of heredity, typically descriptive and not explanatory. Pearson's contribution was to offer a statistical treatment of the majority of parameters involved in both the theory of heredity and the theory of evolution. By doing this, Pearson converted a lot of concepts with strong causal connotations in a system of descriptive formulae relating a number of pleasurable magnitudes. This operation was obviously in agreement with Pearson's philosophical conception of scientific theory as a classification of "abstract" or "descriptive" statements. The last section of my paper will examine the two "laws" that Pearson considered as the most comprehensive laws in biology, the "law of ancestral heredity" and the "fundamental theorem of selection" (not to be confounded with Ronald Fisher's "fundamental theorem of natural selection" formulated thirty years later). For Pearson, the law of ancestral heredity was a necessary component of his fundamental theorem of selection. Taken together, these two laws made possible to transform Darwin's theory into "a genuine scientific theory" through a short mathematical formula articulating Darwin's concept of "variation", "heredity", and "selection". For Pearson, the major merit of this reformulation was to eradicate

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the notion of "explanation", in the sense that himself and other physicists and philosophers (Rankine, Mach, Duhem) gave to this terms. The conclusion of the paper will briefly provide a few elements of the institutional and the political context of Pearson's statistical theory of heredity and evolution: emergence of biometry as a new scientific field on his own right, and social debates about race and eugenics.

AFFILIATED MEETINGS

LOGICAL, MODELLING AND PHILOSOPHICAL FOUNDATIONS OF SCIENCE HISTORICAL DEVELOPMENT, CURRENT INVESTIGATIONS, AND PERSPECTIVES

Tuesday, August 4 • 09:00–10:30 (Chendov and Faust)
Tuesday, August 4 • 11:00–13:00 (Mutanen, Halonen, Pavlov,Nakatogawa)
Tuesday, August 4 • 14:30–16:30 (Müürsepp, Kasak, Cheng, Fan)
Tuesday, August 4 • 17:00–19:00 (Pechenkin, Chukova, Masot-Conde, Mikhajlova & Chendov)
Main Building, Auditorium IV

Organizers:
Chendov Boris
Independent scholar BULGARIA
Müürsepp Peeter
Tallinn University of Technology, ESTONIA
Mutanen Arto
Finnish National Defence University, FINLAND

Abstract structures of logistic as a complex theory unifying methodology of S-modelling and logic of science:

research programme
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1. Basic concepts

1.1. Taking into account the facts of history of science concerning such kind of scientific events which are named "models", "modeling" and "methodology of modeling" following explications of them are proposed:

1.1.1. The concept "**S-modelling-relation of system X into system Y**", defined as approximate homomorphism of system **X** into system **Y**, and in presence of such a relation - the concept "**system Y to be S-model of system X**".

1.1.2. S-modelling-process is a process embracing: **(1)** construction of S-model of a given system, ultimately starting (theoretically or historically) from the experience; **(2)** rational research on the given model, **(3)** consequently application to the system-object of the given S-model, **(4)** consequently – modification of the given S-model, and so on.

1.1.3. Methodology of S-modelling consists of **(1)** mathematical theory of S-models – as kernel, and **(2)** methodological treatment of S- model-concept, modelling-relation, and modelling-process **(2.1)** as previous to S-model-maththeory, and **(2.2)** as superstructure over the S-model-maththeory.

1.2. Taking into account the facts of history of logic and of its applications:

1.2.1. Logic is mathematical theory of acceptance-relation (as explication of the intuitive concept of logical inference in the most general sense), treated on syntactical and semantic levels (the thought is not subject, but is merely a sphere of application of logic, however historically playing the role of starting model for its development like the role of games of chance for the initial development of probability theory).

1.2.2. Logic of science is complex science of acceptance-relation (i.e. of logical inference in the most general sense), including philosophic-methodological, proper-logical, historical, and (emphatically) scientific-applied aspects.

2. Thesis

Logistic is part of the general foundations of science.

3. Basic content:

consecutive exposition of pure formal and semantic treatment of the basic abstract structures of logistic - from explications of intuitive concept "class" (set, collection), through various logical system (the central: dyadic modal logic) to higher mathematical structures.

4 Open problems

To reveal:

(4.1) applied significance of the various abstract structures of logistic to various scientific theories, problems, etc.;

(4.2) the history of foundations of science as a historical process of explicit or implicit realization of S-models and logical systems in their mutual connection.

An extension of EVIDENCE LOGIC: providing a foundational framework for mathematical epistemology

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Evidence Logic (EL) (INTERNATIONAL JOURNAL OF INTELLIGENT SYSTEMS 15 (2000), 477-493) is an extension of Classical Logic whose languages $L_{n,t}$, for any stipulation t of predicate symbols and any n>1, are equipped with the following:

(1) an Evidence Space of evidence values $E_n = \{ i/(n-1) : i = 1,\ldots,n-1 \}$, such that

(2) the atomic formulas are, for any s-ary predicate symbol P and any terms $t_1,\ldots,t_s$, and for any e in E_n,

$$P_c t_1 \ldots t_s : e \text{ and} P_r t_1 \ldots t_s : e,$$

where the former asserts that there is evidence at level e confirming $Pt_1\ldots t_s$ while the latter asserts that there is evidence at level e refuting $Pt_1\ldots t_s$.

Semantically, in any model $\mathcal{A}$ = <A,…> of $L_{n,t}$ each s-ary predicate symbol P is interpreted by *a pair*$\langle P_c^{\mathcal{A}}, P_r^{\mathcal{A}} \rangle$ each coordinate of which is a partial function from A^s to E_n.

To overview the mathematical structure of the Boolean Algebra of Sentences (BAS) and the Topological Space of Models (TSM) of any EL language $L_{n,t}$, we will briefly discuss them in terms of the languages $L_{n,\mu}$ for *decidable*μ stipulating p proposition symbols, k constant symbols, and u unary predicate symbols:

THEOREM. The BAS of $L_{n,\mu}$ has order basis $\omega^m . n^{2p} . ({}_{i=1}\Sigma_k s_{ki} . n^{2ui})$ where ω is the order type of the Natural Numbers, $m = n^{2u}$, and the s_{ki} are the Stirling Numbers of the Second Kind (i.e., s_{ki} is the number of ways of partitioning a k-element set into exactly i non-empty subsets).

The main construction of this talk will, from the epistemological perspective of Explorationism (www.bu.edu/wcp/Papers/Logi/LogiFaus.htm, World Congress of Philosophy 1998), build a dynamic temporal extension of EL. Following this construction, we will discuss its utility in mathematical epistemology.

About Scientific Explanation

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Von Wright (1971, 1974, 1983) characterizes the notion of manipulative causality. The notion is related to the notion of action: the actor is a cause of the result of the act. This manipulative notion has been further developed, for example, by Woodward (2003). According to von Wright the notion of causal explanation is based on this kind of manipulative notion of cause. In an experiment the experimental set up is manipulated by the experimenter. So, it is possible to argue that a kind of manipulative notion of causality is behind the experimental inquiry. It is interesting to analyze different models of explanation are related to the causal explanation. Besides the von Wright's causal explanation we discuss about statistical explanation, cowering law model of explanation, and interrogative model of explanation.

Interrogative Model of Explanation: New Perspectives

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In my dissertation *Interrogative Model of Explanation and Covering Laws* (2001) I presented and defended an approach that might be called an interrogative theory of explanation. The central ingredient of this approach was to understand the problem of explanation in the framework of the interrogative model of inquiry developed by Jaakko Hintikka and his associates. The approach included logical tools new to research connected with scientific explanation. In addition tological tools the study of scientific explanation needs pragmatic tools as well. That is why the theory of questions and answers and the whole interrogative model of inquiry played an important role in this work. One starting point of the inquiry was to use logical interpolation theorems as a means of showing the existence of covering laws and of interpreting such covering laws.

In my paper I shall return to some questions that remained open. They are connected with the role of epistemic logic and the theory of why-questions needed in the context of this kind of approach to explanation.

About Syntactic Representation of Logical Matrix

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Syntactic representations of the logical matrix are constructed for some non-classical logics. Constructing conditions of syntactic representation of the logical matrix define class of AM-logics.

For example, the axiomatizations of Łukasiewicz's logic $Ł_3$ and Bochvar's logic B_3 don't belong to AM-logics, but these logics with adding Słupecki's operator T $Ł^T_3$, B^T_3 belong to AM-logics.

References: Pavlov S.A. *Syntactic Analogues to Proof of the Adequacy Theorem.* 8th Smirnov's Reading in Logic. Moscow, pp. 70-71. 2013.

Methodological reflections on non-standard logics, their relations to empirical sciences, and Tarski's notion of 'semantically complete' language

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Multitudes of nonstandard logics make us wonder which one is the 'true' logic. The list of nonstandard logics includes substractural logics, quantum logic and fuzzy logic. Some of the nonstandard logics were introduced at the foundations of certain areas of empirical science when no further advancement of the science was found almost impossible without resorting to methodological reflections. Examples taken from various kinds of nonstandard logics will be discussed. In particular, various notions of 'mplication' in quantum logic will be analyzed in terms of substructural logics (due to Dr. Takeshi Ueno). These analyses lead us to obtain heuristic ways how to give methodological 'justification' to laws of non-standard logics, provided that they are intrinsically connected to our activities in the actual world. To seek methodological 'justification' one uses meta-language. Due to the occurrence of liar-type paradoxes in the 'semantically complete' language in which all names have reference, Tarski ("Truth and Proof", 1969) confined himself to 'semantically incomplete' meta-languages of specific areas of science such as linguistics and chemistry. We know today that foundational studies of quantum physics, computer programing theory and game theory require non-standard logics. And the meta-investigations about these theories are to be curried out in the specifically restricted meta-languages. Then, each of these restricted 'semantically incomplete' meta-language occupies a certain restricted part in the 'all inclusive language' (hereafter, AIL). Thereby, laws of non-standard logics used in these theories could be interpreted according to the use of the restricted part of AIL. Our present use of language seems to be gradually expanded to reach AIL eventually. The gradualist's view of quasi-empirical view, which was suggested toward the end of Tarski's paper (1968), would then be extended to justify and interpret various kinds of non-standard logics, under the presupposition of the 'manifold' structure of local regions of AIL.

Which Empiricism – Standard or Aim-Oriented?

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The talk addresses the idea of Nicholas Maxwell about the need to reform the current understanding of scientific research called standard empiricism by him and to replace it with aim-oriented empiricism. David Miller and F.A. Muller have criticized the approach. Inscience today, there is a strong belief that any theory becomes established based on evidence alone. In reality, however, hidden metaphysical assumptions, like unity or simplicity, are playing an important role. There can be disunified rival theories there that do better concerning empirical predictions. Aim-oriented empiricism would have the metaphysical assumptions built into it. According to Maxwell, metaphysical assumptions have to be inherent in science itself, not as some kind of independent (hidden) foundation. Aim-oriented empiricism would guarantee that. David Miller suggests that disunified theories are like 'God hypotheses' that are simply excluded from science. All metaphysical hypotheses are also excluded from science and there is no 'standard empiricism' problem that Maxwell is keen about. But many disunified theories do receive serious consideration in science. For instance, there is a disunified rival to Newtonian theory put forward by Maurice Levy. Orthodox quantum theory falls under the same category. Miller fails to notice that the disunified rival theories considered by the argument are sometimes empirically more successful than the accepted unified theory. Any accepted physical theory, Newtonian theory, classical electrodynamics, quantum theory, general relativity and so on – runs into some empirical difficulties and is ostensibly empirically refuted. The criticism of F.A. Muller also seems to stem from a misrepresentation of Maxwell's understanding of standard empiricism. Again, the key issue is the understanding of the role of metaphysical assumptions. Maxwell does recognize that they are there in standard empiricism. But they are not an inherent component that becomes open for possible correction.

On the Limits of Knowledge

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When we concentrate on the results of a discussion, ur contextual or subliminal presuppositions often slide by unanalyzed. In the context of knowledge, this approach is generally justified. But situation changes when we talk about the boundaries of knowledge. It may happen then that judicious presuppositions become hidden implications that narrow our field of regard, not allowing us to comprehend some aspect of the boundary problem discussed. Considering the boundary problems in physics, it is the custom to ask not if a theory is crazy, but if is it crazy enough to be true. This could be interpreted in such a way that an ideal theoretical physicist considering a boundary problem would be able to have judicious doubt in every presupposition or implication.

If philosophers try to find the absolute border that would be basically impossible to cross for the human mind then they might want to be careful with presuppositions. Consider an analytical philosopher who starts a discussion of knowledge by defining knowledge as "*S* knows that *p* iff...". Never mind the following text; such a start would be remarkable enough to entice a closer study. This expression includes presuppositions that it is inevitable to have a subject who knows and an object that is known. Yet if we talk about boundaries of knowledge, both presuppositions can be contested (they might be true but not inevitably). These matters can't be left undiscussed just because they're unwieldy and might seem inexpedient. The history of science shows us that the biggest hindrances in the limit problems are brought on by self-evident truths that lure us into the intelligence trap as described by de Bono.

A Contextual View of Science

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It is a central topic to establish a new view of science for present philosophy of science and the social and cultural studies of science. The image of a traditional view of science is described by its such properties as certainty, objectivity, inerrability and universality. This image has been rejected by the naissance of non-Euclidean geometry and quantum mechanics and the studies of scientific practice. Some of them even tend towards the inverse of it and get a conclusion of anti-realism. The "science war" exposes the conflict between these two kinds of the images and requires us to rethink the problems of objectivity of science based on the dimension of society. The root of their conflict is that they hold the logical thinking way of two values. According on the productions of scientific research in the contemporary time, if we consider the scientific theory as talking about world rather than describing the world, the models of theory as a simulation for world, the objectivity and truth of science as a human cognitive degree concept rather than the relation property about correspondence between objectivity and subjectivity, then we will not need to worry about taking another pole once our find the contextualism and inerrability of scientific knowledge and holding the objectivity of science without rejecting the culture of humanity This is a new "contextual view of science".

Is the Third Wave of Science Studies Coming? Comment on Harry Collins' Philosophy of Expertise

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In the SSK stage, Collins found the 'core-set', developed upstream work of science studies. In order to that, he distinguished expertise as three levels: normal person's expertise, expert's expertise and the expertise which used to judge expert. Collins' philosophy of expertise represent a kind of boundary work: (1) overturn the understanding of 'knowledge'; (2) emphasize the exist of interactional expertise, break the dualistic structure of knowledge; (3) break the boundary of local knowledge and public knowledge; (4) break the boundary of expert and nonexpert; (5) distinguish science as four stage: normal science, golem science, historical science and reflexive historical science.

Key words: Core-set; expertise; the third wave of science studies

To what extent I. Prigogine's non-linear thermodynamics is responsible for the philosophical talks about self-organization

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The article is concerned with the philosophical talks which became popular in the 1980s and keep their popularity till now. This is the philosophical talks (papers, essays) about self-organization. I attempt to find out to which extent these essays are founded on the scientific theory to which they regularly refer, on I. Prigogine's non-linear thermodynamics. As it is said in Wikipedia, "after Ilya Prigogine's

1977 Nobel Prize, the thermodynamic concept of self-organization received some attention of public, and scientific researchers started to migrate from the cybernetic view to the thermodynamic view". In Prigogine's thermodynamic, however, the real base of the conception of self-organization is his concept of dissipative structure. Prigogine provided a descriptive definition of the dissipative structure and constructed the theory of two dissipative structures: the Bernard cells and the Belousov-Zhabotinsky reaction. However, he hypothetically applied this concept to the spatial-temporal structures which are formed in the process of glycolysis and some other phenomena of molecular biology. By replacing the concept of the dissipative structure by the more vague concept of self-organization he together with co-authors extrapolated his approach to some other biological structures, applied it in the field of ecology and sociology. The subsequent step: by placing the concept of self-organization into the framework of the worldview concepts (the picture of the world, the ideals of scientific thought, the contemporary scientific revolution, etc.) Prigogine's co-author s and some other philosophers (for example, Alvin Toffler in his preface to Progogine-Stenger's book) have conducted the extrapolation of extrapolation and came to a kind of what E. Husserl called Weltanschauung (world-view) philosophy.

True, it shall be taken under consideration the development of the concept of the dissipative structure in non-linear dynamics (see Nikolis-Prigogine's writings). However, a gap between thermodynamics and non-linear mathematics arose.

Strong and weak influences in practice of modern western medicine and in philosophy of Chinese (Orient) medicine

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Advances of thermodynamics of irreversible processes in systems under electromagnetic radiation have allowed to discover general laws of influence of any factors on live systems, including on the person. Studying of change of the Helmholtz free energy is necessary for success [1]. The basic results of such consideration have shown, that efficiency dependence on absorbed power submit to two different laws (the Weber-Fechner law and the Devyatkov law) for different frequencies. For any factor there is thermal (strong influence) and non-thermal (weak influence) processes. The newest experimental researches in pharmacology give additional acknowledgement of correctness of the thermodynamic theory and allow to designate new ways for development the medicine, which are connected with transition from therapeutic doses of influence on the person to use of biologically active additives.

References: [1] Yu. P. Chukova. Advances in nonequilibrium thermodynamics of systems under electromagnetic radiation. 2001, Moscow. Khrizostom. ISBN 5-7508-0285-X

New times for scientific communication

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Technology is changing the way Science spreads out. If peer-reviewed journals have so far monopolized the role of intermediation or "bridge" between the scientific idea and its potential users, more and more databases and academic repositories are gaining ground, by offering universal open access versus restricted access to subscribers, and publication immediateness by skipping usually too long revision processes. The success of these new roads for scientific communication is precisely based on the higher and higher technological capacity of computers, both in memory and processing, which allows the massive process of metadata up to unsuspected limits, and has propitiated the change in the paper-selection paradigm. Indeed, these two ways of understanding scientific communication are opposed to each other: strong selection for the sake of quality, versus total lack of selection, for the sake of universality. The high demand for publication in today's world collapses the limited space that a traditional journal can offer, and also their possibilities of handling it. For the sake of agility, the peer-review process is usually skipped by editors, who shoulder the publication decision, despite not being experts on the topic. In contrast, open repositories and their non-selective editorial policy has turned into an advantage what in the past was seen as a disadvantage: the open edition allows omissions or mistakes to be corrected before publication, resulting in much richer outputs. Precisely the non-censure turns into the best censure of all: Not a few eventual individuals but the whole community is the new "Referee", and in a somewhat "*natural/intellectual selection*", the scientific idea will have to compete with others on the same arena, "*surviving*" only if it is strong enough.

Two methodological theses concerning application of the modelling and logic to foundations of psycho-somatic medicine

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§ 1.

Fact 1. During the last a few decades the methods of modelling are applied more and more in the biology and psychology, as well as in the same time in somatic medicine and psychiatrics, correspondingly

Fact 2. Since the 20s years of 20th century an interdisciplinary direction in the frames of medicine initiated and step by step was developed, namely the psychosomatic medicine, unifying elements of somatic medicine, on the one hand, and elements of medical psychology and psychiatrics, on the other hand.

It is quite reasonable on the basis of these two facts to formulate the following methodological thesis for the psychosomatic medicine:

Methodological thesis 1. In the process of theoretical development of the psychosomatic medicine it is reasonable to endeavour to apply complex models, containing two components: somatic submodel and psychic submodel, which can be expressed symbolically by means of using two-components vectors (in a generalised sense).

§ 2.

On the basis of:

the general methodological thesis about correspondence between the type of models applied in the science and the type of logical systems applied in it;

the methodological thesis: there is correspondence between vector-models and vector-logic in which propositions are complex ones, expressed by vectors containing simpler propositions as its components; and

the methodological thesis 1 formulated above, we can formulate the following

Methodological thesis 2. In the process of theoretical development of the psychosomatic medicine it is reasonable to endeavour to apply vector logic.

Note. Speaking about models in scientific knowledge we have in mind the concept S-model as it is defined in the general talk (in the programme of this symposium) of Chendov.

Programme

Organizers:
Chendov Boris
Müürsepp Peeter
Mutanen Arto

9.00-10.30
Opening the meeting: preliminary notes of organizers
Chairman: Peeter Müürsepp
Introductory paper: Boris Chendov – Abstract structures of logistic as a complex theory unifying methodology of S-modelling and logic of science – research programme
Don Faust – An extension of EVIDENCE LOGIC:
providing a foundational framework for mathematical epistemology

10.30-11.00
Coffee

11.00-13.00
Arto Mutanen – About Scientific Explanation
Ilpo Halonen – Interrogative Model of Explanation: New Perspectives
Sergey A. Pavlov – About Syntactic Representation of Logical Matrix

Koji KN Nakatogawa – Methodological reflections on non-standard logics, their relations to empirical sciences, and Tarski's notion of 'semantically complete' language

13:00-14.30
Lunch

14.30-16.30
Chairman: Arto Mutanen

Peeter Müürsepp – Which Empiricism – Standard or Aim-Oriented?
Enn Kasak – On the Limits of Knowledge
Sumei Cheng – A Contextual View of Science
ZHANG Fan – Is the Third Wave of Science Studies Coming? :
Comment on Harry Collins' Philosophy of Expertise

16.30-17.00
Coffee

17.00-19.00
Alexander Pechenkin – To what extent I. Prigogine's non-linear thermodynamics is responsible for the philosophical talks about self-organization
Yu.P. Chukova – Strong and weak influences in practice of modern western medicine and in philosophy of Chinese (Orient) medicine.
Fátima Masot-Conde – New times for scientific communication
Toshka Mikhajlova, Boris Chendov – Two methodological theses concerning application of the modelling and logic to foundations of psycho-somatic medicin

THE LEGACY OF JOACHIM LAMBEK (FOLLI AFFILIATED MEETING)

Tuesday, August 4 • 09:00–10:30 (Dosen, Awodey)
Tuesday, August 4 • 11:00–13:00 (Cocket, Buszkowski, Scott)
Tuesday, August 4 • 14:30–16:30 (Coecke, Casadio, Sadrzadeh)
Tuesday, August 4 • 17:30–19:00 (Morrill, Moortgat)
Main Building, Room 3

Organized:
Moortgat Michael
Utrecht University, NETHERLANDS
Scott Philip
University of Ottawa, CANADA

Speakers:
Dosen Kosta
Mathematical Institute, Serbian Academy of Sciences and Arts, SERBIA
Awodey Steve
Carnegie Mellon University, UNITED STATES
Cocket Robin
University of Calgary, CANADA
Buszkowski Wojciech
Adam Mickiewicz University, Poznan, POLAND
Scott Philip
University of Ottawa, CANADA
Coecke Bob
University of Oxford, UNITED KINGDOM
Casadio Claudia
University of Chieti, ITALY
Sadrzadeh Mehrnoosh
Queen Mary University of London, UNITED KINGDOM
Morrill Glyn
Universitat Politecnica de Catalunya, SPAIN
Moortgat Michael
Utrecht University, NETHERLANDS

Schedule

Morning. Foundations: logic, mathematics

The first part of the meeting is devoted to the impact of Jim Lambek's foundational ideas on category theory, algebra, logic, proof theory and the theory of computation on current work in these areas.

9.00-10.30 (two 45 min talks)
-Kosta Dosen
-Steve Awodey

10.30-11.00 Coffee

11.00-13.00 (three 40 min talks)
-Robin Cockett
-Wojciech Buszkowski
-Philip Scott

13.00-14.30 Lunch

Afternoon. Applications: physics, linguistics

In his latest book, From Rules of Grammar to Laws of Nature (2014), Jim Lambek's interests in the application of mathematical ideas range from the grammatical analysis of natural languages to the use of quaternions in special relativistic quantum mechanics. The second part of the meeting is devoted to current work on resource-logical themes in theoretical physics and formal linguistics, and the connections between these two disciplines via shared categorical structures.

14.30-16.30 (three 40 min talks)
-Bob Coecke
-Claudia Casadio
-Mehrnoosh Sadrzadeh

16.30-17.00 Coffee

17.00-19.00 (two 40 min talks + closing discussion)
-Glyn Morrill
-Michael Moortgat
-Closing discussion

19.00 End

The Legacy of Joachim Lambek

FoLLI Affiliated Meeting. Titles/Abstracts

Steve Awodey. Stack representation for pretopoi: Towards logical schemes

As a PhD student, I was greatly inspired by a paper of Jim Lambek's (with I. Moerdijk), "Two sheaf representations for topoi". In this paper, the sheaf-theoretic methods that Lambek had previously applied in algebra were transferred to logic via category theory. The main result of my own thesis, published as "Sheaf representation for topoi", was an extension of Lambek and Moerdijk's result, which had in the meantime been improved upon by Lambek in the paper "On the sheaf of possible worlds". Soon after my work was published, Jim wrote me a personal note of congratulations and encouragement, which meant a great deal to me.

The basic model for all of these results was Grothendieck's sheaf representation for commutative rings, which forms the basis of his celebrated definition of a "scheme". In subsequent work with two of my PhD students, I have pursued this analogy further: with H. Forssell, we developed the "site" for the sheaf representation of a boolean pretopos as the topological groupoid of models, resulting in a Stone duality for first-order logic. With S. Breiner, we added the "structure sheaf" of local pretopoi, to arrive the notion of a "logical scheme", which combines the syntax and semantics of a logical theory into a single object with both aspects. Essential use is made of tools from categorical logic, as developed by Lambek and those influenced by him. This talk gives a survey of these results.

Wojciech Buszkowski. On syntactic interpretations in Full Lambek Calculus

Full Lambek Calculus is a basic substructural logic. Here Full Lambek Calculus is denoted by FL_1, its 1-free fragment by FL^*, and the subsystem of FL^* not allowing empty antecedents of sequents by FL. This notation differs from a standard one, where FL stands for our FL_1. The pure logicians, however, usually ignore logics like FL in our sense, and we need a notation discriminating these different systems. FL is the original Lambek Calculus (L) augmented with lattice connectives $\wedge, \vee$.

Type grammars (or: categorial grammars) are formal grammars based on type-theoretic syntax and semantics. The language is described by an assignment of types to lexical items (words), and compound expressions are processed by means of a type logic. Type logics are certain basic substructural logics, usually presented as sequent systems: formulae of these logics are interpreted as types. Type grammars often employ logics not allowing empty antecedents of sequents, e.g. L, NL, NL$\Diamond$.

We study some relations between the versions allowing empty antecedents (more popular among logicians) and those not allowing them (more popular among linguists). We reduce the provability in the former systems to the provability in the latter, e.g. FNL^* to FNL, using two translations N and P of formulas in the language of FL (or its extension) into formulas of the same language. N (resp. P) acts on negative (resp. positive) occurrences of subformulae in sequents.

We obtain these results for both nonassociative and associative logics, also admitting structural rules (exchange, integrality, contraction), the distributive laws for $\wedge, \vee$, and unary residuated modalities $\Diamond, \Box^{\downarrow}$.

As a consequence, we obtain a general result on the generative capacity of type grammars allowing empty antecedents. We also extend the theorem of Horčik and Terui (2011) on the PSPACE-hardness of some substructural logics for a large class of logics, extending FNL with restricted associativity.

Claudia Casadio. Quantifiers and scope in pregroup grammar

Developing his calculus of Pregroups, Lambek was particularly interested in wh-dependencies; he also thought it worthwhile to extend the analysis to quantifiers in natural language: this paper follows from a joint project of study in this perspective (see Lambek, "From word to sentence", 2008). We give a geometrical representation of quantified noun phrases and their scope properties by means of the planar graphs of Compact Bilinear Logic — the logic of Pregroups — similar to the proof nets of Non commutative Multiplicative Linear Logic.

Natural language quantifiers occur *in situ* and take scope over arbitrary large contexts. In a typical example, two quantifiers occur in pre-verbal vs. post-verbal position: *Every astronomer loves some star*, admitting two readings, depending on which quantifier, *every* vs. *some*, takes wide scope. We show how similar scope ambiguities can be handled within a Pregroup grammar.

We introduce two new basic types, reminiscent of Montague semantics: **e** (entities), **t** (truth values). Predicates, quantifiers and quantifier phrases are assigned types on the basis of such skeleton grammar: e.g. (e^r t) for IV, (e^r t e^ℓ) for TV, (t t^ℓ e) for subject QP.

The way type calculations proceed from left to right is represented by links drawn between types. There are two kinds of links: under-links for the contractions allowed in the free pregroup; over-links for the expansions admitted on the basis of preceding contractions, since contractions precede expansions. Challenging examples of multiple readings are sentences with nested quantifier phrases. We look at the quantifiers wide vs narrow scope readings as different ways in which information flows within the given contexts. By introducing syntactic types into this basic grammar, one can describe the different properties of quantifiers such as *everybody*, *somebody*, *anybody*.

Robin Cockett. Monoidal Turing Categories and Linear Combinatory Algebras

I first became interested in "abstract computability" during a series of visits to McGill started in 1986 under the gentle tutelage of Michael Barr. Jim Lambek's book (with Phil Scott) was just being published and Jim Lambek was already considering weaker structures associated with the natural number object. They were exciting and formative times.

It was already well understood, from André Joyal's exploration of arithmetic universes, that a "strong" natural number object only gave rise to primitive recursion. Leopoldo Roman, who was also visiting Montreal at the time, proved that, once one had primitive recursion, one could model μ-recursion in the category and, thus all recursive functions. This seemed to indicate that one already had all the power of computability at this level ... and seemed to contradict all the comfortable "facts" I had learnt about computability: in particular, it seemed to contradict my naive understanding of the Church-Turing thesis!

To resolve these contradictions demanded a more abstract view of computability. In 1987 Alex Heller and Robert Di Paola published their work on "recursion theory without elements" — the progenitor of abstract computability. There was, however, a huge chasm between this view of computability and the intimate connection between arithmetic and computability whose unravelling in Montreal had so drawn me to the subject and in which Lambek had played a central role. Indeed, it was not until many years later — in work with Pieter Hofstra on abstract computability — that I began to see how this chasm might be bridged.

While this talk is about abstract computability — as embodied by monoidal Turing categories — Jim Lambek's hand can be felt everywhere: for if he had never developed categorical proof theory in his papers on deductive systems the tools that I use would simply not be available.

This is joint work with Jonathan Gallagher.

Bob Coecke. Quantum theory ∧ grammar = Lambek

There is a surprising communality between quantum theory and grammar, first observed by Jim Lambek, namely, composition of quantum processes as well as composition of grammatical types forms a compact closed category. In the case of grammar this is a Lambek pregroup. This communality extends, when bringing the linear algebraic structure of Hilbert space into the picture, to compositional distributional semantics for natural language meaning. Not only is this communality cute, and allows one to use insights and methods of one area into the other one, but induces quantum computational speed-up for natural language processing.

Kosta Došen. Lambek's proof theory

Lambek's main contributions to logic, which are all in the sphere of general proof theory, are the following. He founded categorial proof theory by pioneering in the 1960s the use of Gentzen methods in category theory and, conversely, the use of the language, rather than the methods, of category theory in proof theory.

He was the first to study explicitly then the problem of identity criteria for deductions, the main technical problem of general proof theory. He contributed, secondly, to understanding the relationship between proof theory and the typed lambda calculus through a result for cartesian and cartesian closed categories that amounts to a decomposition into two adjunctions of the adjunction involving product and exponentiation. He pioneered, thirdly, the investigation of substructural logics, and anticipated linear logic, by the introduction of his calculus of syntactic categories and work on its logical side. Another important contribution to logic, which is not quite proof-theoretical, is his notion of abacus computability.

This talk will concentrate on the first three contributions above, which by their merits should secure for Lambek much more notoriety than that due to many leading contemporary logicians.

Glyn Morrill. From Lambek Calculus to Placement Calculus

Lambek calculus, L, is a multiplicative sublinear logic with a single family of connectives defined and interpreted in relation to concatenation. It finds linguistic application as the logical foundation of categorial grammar. But as a formalism which is essentially continuous it is, like context-free grammar, inadequate with respect to the displacement phenomena of natural language.

Placement calculus, D, is a multiplicative sublinear logic with twin families of connectives defined and interpreted in relation to concatenation, as in L, and intercalation. This enables treatment of the displacement phenomena of natural language.

Here we retread the path from L to D including Bach, Moortgat, Versmissen, Solias, Morrill, Fadda, and Valentn: discontinuous connectives, type-logical discontinuous connectives, sorting, wrap as a defined operation, the separator, vectorial notation, and tree-based hypersequent notation.

Michael Moortgat. Calibrating grammatical composition

As a logic (almost) without structural rules, Lambek's Syntactic Calculus is a non-commutative precursor of multiplicative intuitionistic linear logic. For classical linear logic, V.N. Grishin's 1983 paper anticipates some key ideas. In addition to Lambek's multiplicative product and directional implications, Grishin also considers a multiplicative sum and directional difference operations, together with distributivity principles relating these two families. A compact version of Grishin's classical bilinear logic is then obtained by identifying the two multiplicative operations (and their

AFFILIATED MEETINGS

units) and this is what Lambek proposed as the foundation for the pregroup grammars which he introduced in 1997.

As models of grammatical composition the Syntactic Calculus and its pregroup simplification are problematic in two respects: the built-in associativity of the product operation leads to overgeneration, and the limited context-free expressivity means that well-attested forms of non-concatenative composition cannot be accounted for. Many generalizations of the Lambek calculus have been proposed to address these problems. In my talk, I reinstall Grishin's distinction between multiplicative conjunction and disjunction. I argue that in order to fine-tune the interaction between these two, the grammar logic needs to be equipped with another essential ingredient from the linear logic toolbox in the form of control modalities, sublinear relatives of the !/? exponentials. The role of these modalities is to license restricted forms of reordering and/or restructuring thus allowing the categorial grammarian to navigate between the Skylla of stunted expressive power and the Charybdis of overgeneration.

Mehrnoosh Sadrzadeh. Linear algebraic semantics for natural language through Lambek's pregroups

Logic is precise, language is vague, and linguists have long tried to reduce the latter to the former. Notable is the generative grammars of Chomsky, the first order logic translations of Montague, and the type-algebraic approaches of Lambek. The first two of these are based on abstract semantics built on denotations of objects in the world. More recent theories argue that meanings of words should rather depend on the contexts in which they occur (and not the world); here various statistical methods are developed to retrieve information from large corpora of real text. The mathematical system that formalizes this theory is vector spaces; these have proven very successful in Artificial Intelligence and automatic Natural Language Processing, for instance in document search. Type-logics of Lambek, more evidently pregroups but also the syntactic calculus, provide a very nice bridge to extend the vector space models from words to sentences. Here,the empirical data from corpora is put into grammatical forms and experiments are performed to verify the theoretical predictions of the model. I will present a summary of both the theoretical and empirical work in this area and also some recent results on quantification.

Philip Scott. Algebraic Foundations and the work of J. Lambek

Jim Lambek spent considerable time studying various aspects of traditional Foundations of Mathematics, from Gödel's Incompleteness theorems to Brouwer's Intuitionism, and reinterpreting them using his expertise as an eminent algebraist. In particular, Lambek was a strong supporter of using higher-order logic as a foundation for mathematics. He emphasized the investigation of free structures (e.g. free cartesian, cartesian closed, dogmas, toposes, etc.) as natural models for different foundational phenomena–both syntactic and semantic–raised by early logicians, from Russell to Gödel. I shall survey some of his (and our joint) works on various areas in categorical logic and foundations, from Incompleteness to categorical recursion theory, with some emphasis on lesser-known papers and (if time permits) connections to very recent literature, especially in Computer Science.

"LET'S ACT! – FORMAL MODELS OF COLLECTIVE AGENCY, INTENTION, AND RESPONSIBILITY"

Tuesday, August 4 • 09:20–10:30 (Duijf, Tamminga)
Tuesday, August 4 • 11:00–13:00 (Sergot, Payette)
Tuesday, August 4 • 14:30–16:30 (Lorini, Broersen)
Tuesday, August 4 • 17:00–19:00 (Horty, Ciuni)
Main Building, Room 5

Presented by:
Van De Putte Frederik
CLPS, Ghent University, BELGIUM

General Aim of the Meeting

Collective agency has received significant interest in various domains over the last few decades: social choice theory, ethics, metaphysics, economy, game theory, artificial intelligence, etc. Among philosophers, there has been a growing consensus that group agency is distinct from the mere sum of acts by individuals. It is often claimed that a so-called "shared intention" is crucial for this distinction. However, the way this notion is spelled out differs significantly. For instance, Gilbert [1] argues against Bratman's reduction of shared intention in terms of a (suitably structured) amalgam of personal intentions [2]. One basic disagreement between both authors concerns the role of each member's obligations towards the group, as constitutive of shared intention.

STIT logic – the logic of "seeing to it that" [3, 4] – has proven very successful for the analysis of individual agency and the associated obligations. In recent work, Broersen and others have extended this framework to handle the interaction between choice, knowledge, and intentions (see e.g. [5,6]).

Nevertheless, from the perspective of groups, many logico-philosophical issues remain unsettled. How should we model group agency in a way that it relates to individual agency, but is not reducible to it (as in classical STIT approaches)? Do we need shared intentions at all in order to arrive at an irreducible concept of joint action? If so, can we define shared intentions in terms of individual intentions (along the lines of Bratman's theory of planning agents) and does this allow us to explicate "acting as a group"? How can we model an agent's obligations towards a group that it is a member of, and (when) are these the same as his personal obligations? When and how exactly can a group "as a group" achieve more than a mere collection of its members?

This meeting's aim is to bring together fresh views on these matters, and to stimulate new formal work in order to help clarify ongoing debates in the aforementioned disciplines. In doing so, we want to bridge the gap between, on the one hand, the philosophical literature on joint action, and on the other hand, formal work on group agency.

References: [1] Gilbert, M. Two Approaches to Shared Intention: An Essay in the Philosophy of Social Phenomena. Analyse & Kritik, Vol. 30 (2008), 483-514. [2] Bratman, M.E. Modest sociality and the distinctiveness of intention. Philosophical Studies, Vol. 144 (2009), 149-165. [3] Belnap, N., Perloff, M. and Xu, M. Facing the Future. Oxford University Press, 2001. [4] Horty, J. F. Agency and Deontic Logic. Oxford University Press, 2001. [5] Broersen, J.M. Making a Start with the stit Logic Analysis of Intentional Action. Journal of Philosophical Logic, Vol. 40 (2011), 499-530. [6] Broersen, J.M. Deontic Epistemic Stit Logic Distinguishing Modes of Mens Rea. Journal of Applied Logic, Vol. 9 nr. 2 (2011), 127-152.

Abstracts of the Contributed Talks (in the order of the schedule)

Collective obligations, group plans, and individual actions

Duijf Hein
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Tamminga Allard
University of Utrecht and University of Groningen, NETHERLANDS

We study relations between collective obligations, member obligations, and individual obligations. We say that an individual agent fulfills her individual obligation if and only if she performs one of her deontically optimal individual actions. Likewise, a group fulfills its collective obligation if and only if it performs one of its deontically optimal group actions. Collective obligations and individual obligations do not match: the fulfillment of a collective obligation is neither necessary nor sufficient for the fulfillment of individual obligations. To make amends, we introduce the notion of a member obligation. This is what an individual group member ought to do in order to help ensure that the group fulfills its collective obligation. Member obligations follow from a group plan designed to fulfill the group's collective obligation: by highlighting particular group actions, a group plan specifies the individual actions that are the components of these highlighted group actions. Technically, the public adoption of a group plan updates the deontic ideality of the action profiles in a coordination game. We show that if a coordination game is updated with a good plan (as we define it), then for every individual group member it holds that she fulfills her member obligation specified by the plan if and only if she fulfills her individual obligation in the coordination game that results from updating the original coordination game with the plan. We thus establish a strong connection between collective rationality and individual rationality.

Some forms of collectively seeing to it that

Sergot Marek
Imperial College, London, UNITED KINGDOM

In philosophical logic, most work on the logic of action focusses on agency, that is, on characterising the conditions under which one can say that it is the actions of a particular agent that are the cause of, or responsible for, a certain outcome or state of affairs. The semantics is usually based on a branching- time structure of some kind. The best known examples are probably the STIT logics associated with Nuel Belnap and colleagues, though there are other examples, including a formalism of my own that combines a transition-based account of action with "sees to it that" modalities.

Often, it is not the actions of an individual agent but those of a set of agents, collectively, that bring about a certain outcome. Collective agency has received comparatively little attention. I am going to map out several different forms, several different senses in which one can say meaningfully that it is the actions of a particular set of agents, collectively, that are responsible for a certain outcome. This outcome may be unintentional, and perhaps even accidental; I am deliberately factoring out aspects of joint action such as joint intention, communication between agents, awareness of other agents' intentions and capabilities, even the awareness of another agent's existence. The aim is to investigate what can be said about collective agency when all such considerations are ignored, besides mere behaviour. In passing I will relate my account to some tentative suggestions made by Belnap and Perloff in 1993 on the distinction between what they call "inessential members" and "mere bystanders". I will adjust some of their conjectures and distinguish further between what I call "potentially participating bystanders" and "impotent bystanders".

Group agents – do they make sense?

Payette Gillman
University of British Columbia, CANADA

To address this question, I will discuss the meaning of Martin van Hees' theorems on group responsibility. His theorems say, roughly, that a decision method which always assigns individual responsibility uniformly over a group must be dictatorial. The results are formulated using strategic game forms as decision procedures. However, I suggest a different formal framework for representing these results. The reason for the change is that within a game form the decision procedure and overall power structure are mixed together, whereas I would like to separate them. To that end, I use the formal apparatus of effectivity functions to represent the overall power structure of a society/group, and a representation of decision procedures is then grafted on to that. This method allows me to look, separately, at the properties of decision procedures, and see how they relate to van Hees' results.

I will also change focus from responsibility to the more fundamental property of group agency. If there are problems for group agency, then this may pose problems for responsibility---as long as causal agency is a part of responsibility. Along those lines I look at variations of van Hees' problematic conditions. The conditions he imposes on decision procedures require that there always be some individual who is responsible, and that all of the parties to the decision share responsibility in the same aspects of the decision and in the same manner. I offer different interpretations of these requirements to see whether van Hees' results can be avoided in the case of group agency. The switch from responsibility to agency and the framework I introduce, bring the results into contact with the treatment of agency in stit logic. I end by discussing the upshot of the results for that formalism.

A logical analysis of responsibility attribution: emotions, individuals and collectives

Lorini Emiliano
IRIT, Toulouse, FRANCE

In my talk I will provide a logical analysis of the concept of responsibility attribution; that is, how agents ascribe responsibility about the consequences of actions, either to themselves or to other agents. The talk is divided in two parts. The first part investigates the importance of the concept of responsibility attribution for emotion theory in general and, in particular, for the theory of attribution emotions such as guilt, pride, moral approval and moral disapproval. The second part explores the collective dimension of responsibility attribution and attribution emotions, namely the concepts of collective responsibility and collective guilt. The proposed analysis is based on an extension of the logic STIT with three different types of knowledge and common knowledge modal operators, depending on the time of choice: before one's choice, after one's choice but before knowing the choices of other agents, and after the choices of all agents have become public.

Objectivity versus subjectivity and contribution versus avoidance in a formal theory of shared responsibility

Broersen Jan
University of Utrecht, NETHERLANDS

In this talk I will consider formal theories of shared or partial responsibility, such as the one put forward by van Hees and Braham. I will argue that in theories like these there are (at least) two distinctions that have to be made. The first is a distinction between objective and subjective elements in attributions of responsibility for effects. This distinction is linked – as I will argue – to different notions of responsibility and from a logical point of view it seems wise not to combine them in one and the same semantics for responsibility. The second is a distinction between aspects of contribution and aspects of avoidance in shared responsibility for the outcome of a joint action. I will ask whether, from a logical standpoint, both aspects should be dual or not. From a game theoretic standpoint – the standpoint taken by van Hees and Braham – these distinctions may not seem very important, but from a logic viewpoint aimed at capturing the logics of shared agency and responsibility, they are. I will investigate logical properties aimed at characterizing the different positions along the two mentioned dimensions.

Knowledge based oughts for individuals and groups

Horty John
University of Maryland, UNITED STATES

In a previous book (Agency and Deontic Logic, OUP, 2001), I developed a framework in which individual rights and wrongs could be compared to group rights and wrongs. For example: If a group of does the right thing, does it follow that each individual from that group does the right thing? If each individual from a group does the right thing, does that mean that the group itself does the right thing? The framework within which I addressed these questions was that of standard stit logic, with no knowledge or intensional concepts at all. In recent work, following many others, I have explored ways of introducing knowledge into a stit logic incorporating action types. The work I propose to present at this meeting involves reformulating the earlier theory into this richer framework, and exploring connections between the knowledge-based obligation of individuals and groups.

Knowledge and Agency of Groups under Uncertainty

Ciuni Roberto
Ruhr-Universität Bochum, GERMANY

An interesting insight on the propositional attitudes of groups can be provided by the analysis of the decision-making problem of a group – that is, how a group of agents makes a decision in view of the best responses of all the agents in the group. Indeed, this will crucially reveal the need for given mechanisms of knowledge distribution from individuals to groups, and connections between individual updates and a change in the information state of the given group. In this talk, I approach the problem by analysing the connection between group agency and group knowledge in situations where we have uncertainty of an entire group alongside the uncertainty of the individuals in the group. This is done by a semantics that (1) combine the basic features of STIT logic with the representation of uncertainty in terms of type-spaces from Bayesian Games, (2) allows for announcements that reveal correct type-spaces and decrease the uncertainty of the group, while at the same time modelling notions of individual and distributed knowledge and belief. The talk is divided in two parts. In the first part, I introduce the 'statics' of the framework, including a notion of 'knowingly seeing to it that' and a notion of belief based on a plausibility ordering. In the second part, I introduce the 'dynamics', that is the update mechanism that allows individuals and groups to decrease their uncertainty about the background of their interaction. Particular attention will be paid to two topics: (1) the way updates on one agents' correct type affect the knowledge of an entire group including the agent, and (2) the issue of Ramsey conditionals connecting the knowledge (belief) of a group conditional on some type and what the group unconditionally comes to know (believe) after the type is announced.

Programme Schedule

The meeting will start at 9h20. Each talk will take 1 hour (including 15 minutes of Q&A and discussion). The coffee breaks will coincide with those of the main track of CLMPS2015.
9h20 – 9h30: brief introduction by Frederik Van De Putte
9h30 – 10h30: Tamminga & Hindriks
10h30 – 11h00: coffee break
11h00 – 12h00: Sergot
12h00 – 13h00: Payette
13h00 – 14h30: lunch break
14h30 – 15h30: Lorini
15h30 – 16h30: Broersen
16h30 – 17h00: coffee break
17h00 – 18h00: Horty
18h00 – 19h00: Ciuni

MATHEMATICAL OBJECTIVITY BY REPRESENTATION

Wednesday, August 5 • 11:00–13:30 (Heinzmann,, Naibo, Korbmacher)
Wednesday, August 5 • 14:30–16:45 (Campbell-Moore, Schindler, Sundholm)
Wednesday, August 5 • 17:15–18:45 (Stern, Büttner)
Main Building, Room 8

(Long Symposium: 4 hours, 8 speakers)

Presented by
Steinberger Florian
CMP, LMU, Münich, GERMANY
Panza Marco
CNRS, IHPST, Paris, FRANCE

As far as the physical world is concerned, the standard realist attitude which conceives of objects as existing independently of our representations of them might be (*prima facie*) plausible: if things go well, we represent physical objects in the way we do *because they are so-and-so.* In contrast, one could be willing to argue, in the mathematical world the situation is reversed: if things go well, mathematical objects are so-and-so *because we represent them as we do*. This does not mean that mathematics could not be objective: mathematical representations might be subject to constraints that impose objectivity on what they constitute. If this is right, in order to understand the nature of mathematical objects we should first understand how mathematical representations work. In the words of Kreisel's famous dictum: "the problem is not the existence of mathematical objects but the objectivity of mathematical statements"

The problem concerns the philosophical question of clarifying the role of representations in mathematical reasoning and proofs and the way they contribute to mathematical ontology and understanding. This is a fresh inquiry concerning a classical problem in philosophy of mathematics connecting understanding to proofs and to the way the ontology of mathematic is conceived. But the starting point is neither classical proof theory nor classical metaphysics. Rather the question is how appropriate domains of mathematical (abstract) objects are constituted, by appealing to different sorts of representations, and how appropriate reasoning on them are licensed.

The Role of Representation in Explanatory Proofs

Heinzmann Gerhard
Laboratoire d'Histoire des Sciences et de Philosophie — Archives Henri-Poincaré, Université de Lorraine, FRANCE
CNRS, Nancy, FRANCE

In the last decades, many studies (an important source is Steiner 1978, a very recent paper is Frans/ Weber 2014) have aimed to give some symptoms for distinguishing evident or convincing proofs (Descartes) from only stringent proofs. Even taken together, all these studies, often undertaken in the spirit of the practical turn in philosophy of mathematics give no convincing answer. Hence my focal concern: can pragmaticism combined with the practical turn in philosophy of mathematics serve as tool in order to give some hints in direction of a more convincing answer? Serious studies of the role that could play pragmatism in understanding mathematical practice are still in their early beginnings (cf. R. Wagner 2010, Pietarinen 2010, Carter 2014) and this is why the question is one part of our research-project *Mathematics: Objectivity by Representation*.

According to Poincaré and Peirce, an explanatory proof "exceeds" a proof conceived as a sequence of propositions whose premises and conclusion are identified by means of models of a certain type. There are at least two possibilities to interpret this situation:

First, one could argue that one have to use a new *logic* with "contentful" inferences for rendering mathematical reasoning. Second, it is so as it is because an explanatory proof includes necessarily categories of mathematical representation. According to this account, an explanatory proof refers also to topic specific mathematical representations, for example to a characterizing property of an entity or a structure mentioned in the theorem. And this is what makes some mathematical proofs better than others. I will pursue this account by presupposing van Fraassen's position (1980): Nothing is an explanation *simpliciter* but only relative to the context dependent why-question(s) that it answers. According to Resnik (1987, 153), one should not conflate all why-questions under the one form of words 'why is the proposition rigorous'? In this sense, the why-question with respect to the "explanatory character" of the proof could concern the possession of an "intuitive insight", i.e.

P knows the guiding lines or, according to Poincaré's metaphor, the "architecture" of the proof, i.e. the arches of the arcades once the construction is finished (Poincaré 1908, XIV).

In the spirit of Nelson Goodman, I argue for the thesis that the "architecture" must be exemplified by intuition. In the standard model of intuition, its pertinence is measured by the adequacy between the subject and its representation. On the contrary, in the here-proposed model, called skill model, the function of intuition concerns a specific pragmatic use one makes of the semiotic system implied. *A proof gives an "intuitive insight" if it contains intuitive language use, i.e. if "parts" of it can be interpreted as exemplifications of a general idea (schema). The insight increases in proportion to the intuitive proof stages*.

In the last section of the paper, different proofs of the irrationality of √2 serves to discuss the thesis.

Bibliographical references: Carter, J. (2014), "Mathematics Dealing with 'hypothetical States of Things'", *Philosophia Mathematica*", 22, 209-230.
Frans, J. / Weber, E. (2014), "Mechanistic Explanation and Explanatory Proofs in Mathematics, *Philosophia Mathematica* 22 (2), 231-248.
Pietarinen, A.-V. (2010), "Pragmaticism as an Anti-Foundationalist Philosophy of Mathematics", in: Van Kerkhove, Bart et al. [2010], 155-183.
Poincaré, H. (1908), *Théormodynamique*, 2e édition, Paris, Gauthier-Villars.
Resnik, M. D. and Kushner, D. (1987), "Explanation, Independence and Realism in Mathematics", *Brit. J. Phil. Sci.* 38, 141-158.
Steiner, M. (1978), Mathematical Explanation, *Philosophical Studies* 34, 135-151.
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Reductive and hermeneutic Nominalism

Büttner Kai
University of Zurich, SWITZERLAND

I will compare the reductive nominalism of Goodman and Quine with Wittgenstein's hermeneutic nominalism. And I will argue that the latter avoids the main difficulties of the former. Quine's and Goodman's aim is to defend their ontological intuition that there are no abstract entities. Since they apparently purport to refer to such objects, arithmetic propositions are deemed meaningless. As a surrogate for arithmetical propositions Quine and Goodman propose propositions about the syntactic properties of tokens of arithmetic expressions. However, this suggestion faces the difficulty of reconciling the fact that there are only finitely many numeral-tokens with the assumption of standard arithmetic that there are infinitely many numbers. Wittgenstein's aim is to describe the use of arithmetical propositions. And such a description, he believes, need not invoke any abstract entities. Since arithmetic propositions are generated and decided by constructing arithmetic proofs, an arithmetic proposition can be taken to claim the constructability of a corresponding proof. Although he thereby construes arithmetic propositions as having syntactic content, Wittgenstein can avoid the infinity problem by adopting an appropriate interpretation of arithmetic existential propositions. Accordingly, a number exist, not if a corresponding numeral-token actually exists, but if talk about the existence of such a token is coherent.

Representing inferences and proofs: the case of harmony and conservativity

Naibo Alberto
Univ. of Paris 1 Panthéon Sorbonne, FRANCE

Traditionally, proof-theoretic semantics focuses on the study of logical theories from a general point of view, rather than on specific mathematical theories. Yet when mathematical theories are analyzed, they seem to behave quite differently from purely logical theories. A well-known example has been given by Prawitz (1994): adding of a set of inferentially harmonious rules to arithmetic does not always guarantee to obtain a theory which is a conservative extension of arithmetic itself. This means that outside logic the nice correspondence between harmony and conservativity — advocated for example by Dummett (1991) — seems to be broken. However, as it has been pointed out by Sundholm (1998), this is not necessarily a consequence due to the passage from a logical setting to a mathematical one. It could depend also on the way in which proofs are represented. In particular, if proofs are seen as composed by rules which act on judgments involving proof-objects, rather than on rules which act on propositions, then the aforementioned correspondence can be in fact be reestablished. An analysis of this phenomenon is proposed here. First, arithmetic is extended with a local reflection principle in the style of Feferman (1962). Secondly, a proof-term decoration of the inference rule corresponding to this principle is provided. Finally, an analysis of conservativity is given by interpreting the decoration of this rule in Artemov's system of logic of proofs (see Artemov 1994).

Bibliographical references: Artemov, S. (1994). "Logic of proofs". *Annals of Pure and Applied Logic*, 67 (1–3): 29—59. Dummett, M. (1991). *The Logical Basis of Metaphysics*. London: Duckworth. Feferman, S. (1962). "Transfinite recursive progressions of axiomatic théories". *The Journal of Symbolic Logic*, 27 (3): 259—316. Prawitz, D. (1994). Review of "The Logical Basis of Metaphysics" by Michael Dummett. *Mind*, NS, 103 (411): 373–376. Sundholm, G. (1998). "Proofs as acts and proofs as objects: Some questions for Dag Prawitz". *Theoria*, 64 (2--3): 187–216.

Dummett and "Kresiel Dictum"

Sundholm Göran
Leiden University, NETHERLANDS

Michael Dummett has made famous "Kreeisel's Dictum" that "the problem is not the existence of mathematical objects but the objectivity of mathematical statements". In the talk, three things will be accomplished:

1) Discuss where Kreisel's enormous *œuvre* the Dictum can be found;
2) Report on Kreisel's explicit 1978 rejection of the Dictum;
3) Challenge Dummett's adherence to the Dictum in his work.

Bibliographical references: Michael Dummett, 'The Philosophical basis of Intuitionism', in: *Logic Colloquium'73*, ed. by H.E. Rose and J.C. Sherpherdson (Amsterdam, 1975) pp.5–40; Georg Kreisel, 'Wittgenstein's Remarks on the Foundations of Mathematics, *British Journal for the Philosophy of Science* 9, No. 34, August 1958, 135-57; Crispin Wright, *Wittgenstein of the Foundations of Mathematics*, Duckworth, London, 1980.

AFFILIATED MEETINGS

Structuralism Based on a Computable Infinitary Logic

Campbell-Moore Catrin
MCMP, GERMANY

In a structuralist philosophy of mathematics arithmetic is about a single, intended model but first order logic has the defect that no set of sentences will be able to pick out this intended model. We discuss some alternative logics which extend first order logic and can pick out this intended model of arithmetic. We develop an infinitary logic which allows conjunction over possibly infinite sets of formulae with the condition that the formula obtained has a computable syntax tree. This logic is more expressive than first order logic but, as opposed to other infinitary logics, the formulas can be fully grasped and, as opposed to in second order logic, the semantics can be fully grasped. Properties of logics that we consider include the Beth property, which says that if a concept is implicitly definable then it is explicitly definable, and whether the logic has a complete proof system. This would therefore give a good foundation for a structuralist philosophy of mathematics, at least insofar as arithmetic is concerned.

What are Structural Properties?

Johannes Korbmacher
MCMP, GERMANY

Informally, structural properties are usually characterized in one of two ways: either as the properties expressible purely in terms of the primitive relations of mathematical theories, or as the properties that hold of all structurally similar mathematical objects. In this talk we present two formal explications of structural properties, corresponding to these two informal characterizations. We wish to reach two goals: First, we wish to get clear on how the two accounts capture the intuition that structural properties are "grounded in structure". Second, we wish to understand the relation between the two explications of mathematical properties. As we will show, the two characterizations do not determine the same class of properties. From this observation we draw some philosophical conclusions about the possibility "correct" analysis of structural properties.

Reference graphs, games for truth, and semantic paradox

Schindler Thomas
MCMP, GERMANY

We introduce a game-theoretic semantics for Kripke's (1975) and Leitgeb's (2005) theories of truth. The grounding game G(A, S) is such that the verifier has a winning strategy in it if and only if A is grounded in S. The verification game V(A, S) is such that the verifier has a winning strategy in it if and only if A is true in the fixed point generated by S The strategies available in these games can be interpreted as reference-graphs of the sentences of the language of truth. In this way, we provide a framework for a graph-theoretic analysis of the Kripke-paradoxical sentences. (As far as we know, this is the first attempt to give a graph-theoretic analysis of the paradoxes for first-order languages such as that of Peano Arithmetic.) It is shown, amongst others, that Leitgeb's notion of self-reference is Delta^1_1; that circularity is a neccessary condition for finite paradoxes; that a sentence is grounded if and only if its reference-graph is well-founded; that a sentence is not Kripke-paradoxical if its reference-graph is a tree; and that any Kripke-paradoxical sentence either contains a loop or infinitely many "double arcs". We compare our framework to those developed for infinitary propositional languages, and state a conjecture how the characterization problem for both languages can be solved.

A New Norm for Truth

Johannes Stern
MCMP, GERMANY

A central norm for theories of truth asserts that for all sentences φ the so-called T-sentence $T\ulcorner\varphi\urcorner \rightarrow \varphi$ should be derivable within the theory. However, this norm cannot be satisfied if classical logic is assumed because of Tarski's famous undefinability theorem. The question then arises what an alternative but satisfiable norm should look like. One way is to require the T-sentences to be derivable for a set of certain sentences only. This option has proven more problematic than one might think---especially for axiomatic theories of truth. The problem is that it proved notoriously difficult to come up with a "big", recursive and well-motivated set of sentences for which one can consistently maintain all T-sentences. As a consequence we propose a change of perspective and propose to abstract away from the question whether a theory proves the T-sentence for a particular sentence Rather we view the initial norm as characterizing the logic of truth, that is a modal operator logic that is axiomatized by the modal principle $\Box$ ® . Tarski's undefinability theorem shows that we cannot adopt the full logic of truth in the presence of liar-like or other self-referential sentences. But we can try to find a sublogic of the logic of truth that is consistent in the presence of self-reference and for which no logic properly extending it is consistent. In other words we can require the modal logic of a theory of truth to be a maximal modal logic in this sense---a logic that gets as close to truth as it is possible. In this talk we shall explain and discuss this alternative norm for truth. In particular, using a recent result by Czarnecki and Zdanowski we show that the modal logic of symmetric theories of truth is maximal in this very sense.

MATHEMATICAL OBJECTIVITY BY REPRESENTATION

Organized by
Florian Steinberger (CMP, LMU, Munich)
Marco Panza (CNRS, IHPST, Paris)

11h00-11h45
Gerhard Heinzmann (Laboratoire d'Histoire des Sciences et de Philosophie — Archives Henri- Poincaré, Université de Lorraine/CNRS, Nancy): The Role of Representation in Explanatory Proofs

11h45-12h30
Alberto Naibo (IHPST, Univ. of Paris 1 Panthéon Sorbonne): Representing inferences and proofs: the case of harmony and conservativity

12h30-13h15
Johannes Korbmacher (MCMP): What are Structural Properties?

Lunch Break

14h30-15h15
Catrin Campbell-Moore (MCMP): Structuralism Based on a Computable Infinitary Logic

15h15-16h00
Thomas Schindler (MCMP): Reference graphs, games for truth, and semantic paradox

16h00-16h45
Göran Sundholm (University of Leiden): Dummett and "Kresiel Dictum"

Coffee Break

17h15-18h00
Johannes Stern (MCMP): A New Norm for Truth

18h00-18h45
Kai Büttner (University of Zurich)

REDUCTIVE AND HERMENEUTIC NOMINALISM A SOCIAL PHILOSOPHY OF SCIENCE

Wednesday, August 5 • 14:45–17:45
Main Building, Auditorium IV

a. The names and email addresses of the organizer(s) and the speakers of the affiliated meeting with their homepage addresses.

Kasavin Ilya
Institute of Philosophy, RAS, RUSSIA
itkasavin@gmail.com;
http://eng.iph.ras.ru/kasavin.htm

Harré Rom
Georgetown University, USA
harre@georgetown.edu
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Rockmore Thomas
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b. A description of the aim and scope of the meeting

An idea of social philosophy of science aims at the revisiting the agenda of the current STS. New movements in understanding science-society interaction require more realistic image of knowledge as complex, self-developing, human-dimensional system that could be separated from the context only in abstraction. Accordingly, its analysis is impossible without a proper social ontology and interdisciplinary interrelation of the social and the human sciences.

The topicality of philosophy of science is linked with the necessity to develop world economy within the parameters of the 6th technological order. This order presupposes such kind of the science-consuming restructuring of production and management, when intellectual abilities, skills and diverse knowledge types as characteristics of productive forces, the horizontal regulation of creative activity, "soft" dialogic forms of organization and communication enter the front edge. The scientific and philosophical studies of the cognitive and social dimensions of science and technology being determined by the level of scientific and social growth essentially influence the subject matter of their own. The historical correlation of rapid development of science and technology (industrial revolution) and the rise of philosophy of science in the middle of the 19th century might be assessed as a form of positive feedback.

And yet the tradition of science studies develops on the basis of the partly out of date post-positivist concepts of science and technology. A philosophy of science as a scholarly discipline exists today side by side with other disciplines within an interdisciplinary framework of the history and philosophy of science (HPS) or science and technology studies (STS). The rationale for this "joint venture" is commonly seen in the division of labor. The history of science focuses on the rise and development of scientific theories in the past; the sociology of science deals with science as a social institution; the psychology of science investigates the mechanisms of creativity and one's personal impact upon scientific discoveries; and finally, the philosophy of science is responsible for the logical and methodological analysis of the structure and growth of the scientific knowledge, mostly within the context of justification. This allegedly fruitful division of labor presumes an independent existence of social, personal and cognitive domains, and the desired interdisciplinary communication between the correspondent disciplines aims to account for the complementary understanding of science. But in fact no sufficient exchange of meanings takes place for every discipline insists upon its independence and prior significance. Under these conditions, neither a consistent picture of science appears to be possible nor might science policy be construed and justified basing on this disintegrated conglomerate of knowledge. A way out of the dead end must be found out to save philosophy of science as a prospective enterprise.

The idea of piecemeal social engineering lies in the background of the current philosophy of science and STS being opposed to utopian social forecasting and projecting. It means the prohibition of the global prognostics and social construction of the future, which allegedly leads to unforeseen results and negative consequences. This comes to dissent with the well-accepted facts of world globalization, although the latter is hardly conceived as an account of overall interconnection and interdependence of world variety but rather as total movement following the standards of the developed countries. Thereby science studies mostly justify and legitimize the established science policy propagating narrow empirical methodology (reductionism, naturalism) devoid of any prospective philosophy and world view. Science studies come to be merely descriptive in their analysis of the current status quo and insist on the negative attitude to those philosophical and scientific trends (feminist epistemology, Marxism, Russian cosmism, post – and transhumanism) that make emphasis on the significance of the long term social forecasting, planning and projecting. At the most this has already led to a certain internal conceptual crisis, which some of the advanced representatives of science studies criticized (B. Latour, S. Fuller, D. Mackenzie etc.). All this requires problematization, critical analysis and conceptual revision of the socially oriented philosophy of science. One of the possible gateways might be a revision of disciplinary structure of science studies and the actualization of their philosophical components; the reanimation of the idea of global projecting and its critical consideration.

c. Short (max 300 words) abstracts of the planned talks

How an affordance based on philosophy of chemistry makes room for social and personal factors in the research process?

Harré Rom
Georgetown University, USA

The `standard model' of scientific research and theorising assumes that by continuous refinement of methods and concepts we can reach knowledge of the material world that is unmediated by any intervening processes. This is the picture inherited from Locke and the philosophy of science of Robert Boyle. However, science is the product of the work of particular people in particular places in particular cultural conditions. Every scientific claim involves indexical marks of its origins. By adopting an affordance analysis of scientific work, and linking this with the concept of the Umwelt we can open up a necessary space for social and personal considerations at the heart of the scientific project. These are made clear by making use of the recent discussion of mereological fallacies, in attempting to reason from knowledge of wholes to that of their parts and vice versa.

Social Philosophy of Science: A New Turn in STS

Kasavin Ilya
Institute of Philosophy, RAS, RUSSIA

What is peculiar for a social philosophy of science? It is inspired by the idea of the unity of the human mind (A.N. Whitehead, W. Quine, Russian cosmists). Today there are many reasons to justify this holism in order to find the way through various methodological and value controversies. Nearly every basic epistemological concept represents a controversy of this kind. It is the case e.g. with the concepts of rationality and truth, which balance between the technical, instrumental, formal approaches, on the one hand, and the abstract, fuzzy, metaphysical ones, on the other hand. Neither the former nor the latter go beyond the well-known classical philosophical trends, which hardly correspond to a variable, dynamic, contradictory picture of the different cognitive practices within the multiplicity of their cultural and social contexts. Although the history and sociology of science and culture gradually and tacitly approach this picture, they lack proper methodological tools.

The way to the theoretically rich and practically applicable image of knowledge might be provided by the concepts like "activity", "communication", "context", "culture", "discourse", "dialogue", "author". The correspondent appeal to overcoming a demarcationist approach often lacks understanding. Rigid boundaries limiting the transdisciplinary scope of epistemological study determine a number of negative consequences. There are: 1) the exaggerated separation of the philosophical disciplines from one another (epistemology, philosophy of science – social philosophy, ethics, anthropology, religion studies etc.); 2) the consequent methodological weakness of non-epistemic studies; 3) the empirical emptiness and practical impotence of epistemology; 4) the idealized and perverted picture of the history of science; 5) the unbridgeable gap between "the cognitive" and "the social". Taking seriously the "internal interaction" between science and society requires a new turn in STS.

AFFILIATED MEETINGS

Hegel, Newton and epistemic constructivism

Rockmore Thomas
Duquesne University, USA

Epistemic constructivism, which arises in modern philosophy in Hobbes and Vico, is central to German idealism. Kant's a priori form of epistemic constructivism is succeeded by Hegel's a posteriori form. From his a posteriori epistemic perspective Hegel criticizes Kantian philosophical epistemology and Newtonian scientific epistemology in formulating an alternative approach. Hegel's approach to cognition in both philosophy and science is broadly hermeneutic. This paper examines Hegel's critique of Newtonian science. This critique runs throughout Hegel's writings beginning with his Dissertation on the orbits of the planets. I argue Hegel successfully criticizes Newtonian science, which he correctly assimilates to Kant's a priori approach. I further argue that Hegel's constructivist approach to scientific cognition is up to date in two ways. First, long before Dilthey, Hegel thinks, on the contrary, that knowledge of nature requires interpretation of nature. Second, Hegel's a posteriori alternative integrates the social aspect into science but avoids collapsing the scientific into the social while also maintaining empirical realism.

The Role of Social Scientists: The Diverse Virtues of Social Knowledge

Ruser Alexander
Zeppelin University, GERMANY

Three issues that are at the core of reflections about the societal role of social science knowledge are addressed:

(1) Social scientists if they self-consciously chose to do so tend to follow -- although this is not always a deliberate choice -- one of three models that describe their role as the producers of practical knowledge. However, the practical virtue of social science knowledge is not only determined by its producers. Even more significant for the kind of practical impact of the social sciences, the "users" of their knowledge treat social science knowledge as indicative of performing practical "work" following one of our three models. For the sake of simplicity we have called the three models, the model of the technician, the model of the advisor and the model of the meaning producer.

(2) The matter becomes more complicated as the result of the need of social inquiry to adopt a particular restrictive perspective of their domain. Hence a widely supported notion, at least among social scientist, must be put into question: when asked about the reasons for the limited "power" of social science knowledge the response frequently is that the adequacy and practical usefulness of social science knowledge is a function of capturing the full complexity of what indeed are complex social phenomena.

(3) Social scientists often tend to lament about the marginal impact their intellectual efforts have on society and they glance with great envy across the divide of the so-called two cultures and wonder how and when they will be able to achieve the same kind of success and prestige the natural science and technology appear to enjoy in most societies. However, this dejected view systematically understates the actual power of social science knowledge, in particular in its role as meaning producers.

d. A preliminary program of the affiliated meeting

The meeting is planned for two afternoons (5-6 August 2015), 14.00 – 17.00.

At least four main papers will be presented and discussed (Kasavin, Rockmore, Harre, Ruser).

The participation of the following scholars as possible speakers and commentators is expected: Finn Collin (Copenhagen University), Alexander Antonovsky (Institute of Philosophy RAS), Inanna Hamati-Ataya (Aberystwyth University), Joan Leach (Queensland University)

The discussion will focus on the following questions:

1. Is there any possibility to save or justify the image of knowledge as a mirror copy of reality? If not, how could it be transformed or dismissed?
2. Is it necessary to overcome the "demarcationist" view of knowledge as identical with science? How can it be done without mixing science with non-science?
3. Should epistemology and philosophy of science strengthen the role of the creative cognitive agent? How can this concept be explicated and defined?
4. Does the conceptualization of creative cognition necessarily imply any form of social constructivism? What are the prospects and limits of naturalistic account of creativity?
5. To what extent does philosophy of science keep its independence from other philosophical disciplines?
6. Are there any reasons to revisit the epistemological status of the natural sciences as the only cognitive ideal?
7. Should new philosophical interpretations be viewed as a necessary feature of any case study? Or could be the latter considered as a new version of the "neutral language of observation", which gives a "crucial justification" of a theory?

PROOF THEORY OF MODAL AND NON-CLASSICAL LOGICS

Friday, August 7 • 11:00–13:00 (Avron, Iemhoff, Wansing, Ciabattoni, Freschi, Genco, Lellmann)
Friday, August 7 • 14:30–16:30 (Palmigiano, Graziani, Maffezioli, Orlandelli)
Friday, August 7 • 17:00–18:30 (Olivetti, Kurokawa, Negri)
Main Building, Room 14

Organized by:
Corsi Giovanna
University of Bologna, ITALY
Negri Sara
University of Helsinki, FINLAND

Presenters:
Avron Arnon
Tel-Aviv University, ISRAEL
Iemhoff Rosalie
Utrecht University, NETHERLANDS
Wansing Heinrich
Ruhr-University Bochum, GERMANY
Ciabattoni Agata
Vienna University of Technology, AUSTRIA
Freschi Elisa
Vienna University of Technology, AUSTRIA
Genco Francesco A.
Vienna University of Technology, AUSTRIA
Lellmann Bjorn
Vienna University of Technology, AUSTRIA
Olivetti Nicola
Aix-Marseille University, FRANCE
Kurokawa Hidenori
University of Helsinki, FINLAND
Negri Sara
University of Helsinki, FINLAND

CLMPS 2015 affiliated meeting proposal: Proof theory of modal and non-classical logics

Giovanna Corsi* and Sara Negri**

1 Aims and description

In recent years, alongside with the publication of pessimistic views on the possibility of developing satisfactory proof systems for modal logic, there has been an impressive burst of new ideas, methods, and results for the proof theory of modal and non-classical logics. All such endeavours converge to the creation of novel inferential methods that cover a wide variety of logics for which no analytic proof systems were previously known; they extend the methods of structural proof theory from pure logic to philosophical logics and axiomatic theories, and use a well developed semantic apparatus as a ground for the generation of proof systems.

The purpose of this affiliated meeting is to bring together experts who are contributing to this growing field, to present their recent work and share ideas with a more generous time frame for talks and discussion and a specialized audience.

The following specific topics will be treated by the talks to be presented at the meeting:

- Gentzen's systems and contraction-free sequent systems
- The widening scope of inferentialism
- Beyond Gentzen's systems: labelled, hypersequent, display, and nested sequent calculi

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**Department of Philosophy, History, Culture and Art Studies, University of Helsinki, e-mail: sara.negri@helsinki.fi, `http://www.helsinki.fi/~negri/`

- Metatheorems: cut elimination, completeness, correspondence, interpolation, decidability
- Applications: Euclid's geometry, bi-connexive logic, counterfactuals, conditional logics, deontic logic, relevance (or relevant) logic, social choice theory
- Comparisons between proof systems for modal and non-classical logics

2 Contributors and abstracts

Arnon Avron (Tel-Aviv University, Israel, `http://www.cs.tau.ac.il/~aa/`, e-mail: aa@math.tau.ac.il):

Using Assumptions in Gentzen-type Systems

The consequence relation between formulas which is induced by a fully structural Gentzen-type system G is usually taken to be: $\Gamma \vdash_G \psi$ iff the sequent $\Gamma \Rightarrow \psi$ is provable in G. However, no less useful is the consequence relation $\vdash^v_G$ defined by: $\Gamma \vdash^v_G \psi$ iff the sequent $\Rightarrow \psi$ is derivable in G from the set of sequents $\{\Rightarrow \varphi \mid \varphi \in \Gamma\}$. This is one particular case in which it is useful to infer a sequent from a set of assumptions where these assumptions are again sequents. We present several other examples of the usefulness of such inferences, like coherence of canonical and quasi-canonical systems (which determines whether such a system is analytic or not), and the problem of processing information from different sources, where the use of sequents is not only useful, but really essential for the expressive power of the logic.

The main technical tool used in the various applications we present is a generalization of the usual cut-elimination theorem (which treats only assumptions-free derivations) to what we call the *strong cut-elimination theorem* (which applies also to derivations of sequents from other sequents). We describe (with examples) several methods for proving strong cut-elimination in systems:

- Prove ordinary cut-elimination. Then prove the strong cut-elimination by induction on the number of premises. (This works fine if the system is *pure* and closed under weakening).
- Use some version of Gentzen's syntactic proof for LK and LJ.
- Use semantic methods.

Our examples of the use of these methods include the propositional provability logic GL, hypersequential systems for Gödel-Dummet logic and some paraconsistent extensions of it, and classical first-order logic.

Agata Ciabattoni, **Elisa Freschi**, **Francesco A. Genco**, and **Bjorn Lellmann** (Vienna University of Technology, Austria, `http://www.logic.at/staff/agata/`, e-mail:agata@logic.at):
Mimamsa deontic logic: proof theory and applications

We define a new deontic logic justifying its components with principles contained in texts of the Mimamsa school of Indian Philosophy. We use general proof-theoretic methods to obtain a cut-free sequent calculus for this logic, resulting in decidability, complexity results and neighbourhood semantics. The latter is used to analyse a well known example of seemingly conflicting obligations contained in the Vedas which proved to be a stumbling block for a number of interpretations of Mimamsa scholars.

Pierluigi Graziani (University of Chieti-Pescara, Italy, `https://sites.google.com/site/grazianipierluigi/`, e-mail: pierluigigraziani@yahoo.it):
Proof theory for non-classical Euclid's geometrical logic

The talk focuses on whether formal logic constitutes a valuable instrument for analyzing ancient mathematics. Starting from the mid-seventies*, this question has been the subject of a new wave of interest. Yet it can be traced back to previous formal renditions of syllogistic logic**.
I will first analyze different contemporary foundations of Euclid's geometry from a logical point of view*, then look at them against the backdrop of current philological studies. In particular, these proposals will be analyzed with respect to:

- the role of geometrical construction procedures;
- the role of diagrams;
- their answers to the generalization problem;

*Hintikka and Remes [1974]; Hintikka and Remes [1976]; Mueller [1981]; Mäenpää and von Plato [1990]; Mäenpää [1993; 1997]; von Plato [1995; 1998]; Mumma [2006]; Graziani [2007; 2014]; Miller [2008]; Mumma and Avigad and Dean [2009]; Beeson [2009; 2012; 2014]

**Notably Lukasiewicz [1957].

*For example: Mueller [1981]; Mäenpää and von Plato [1990]; Mäenpää [1993; 1997]; von Plato [1995; 1998]; Mumma [2006]; Graziani [2007; 2014]; Miller [2008]; Mumma and Avigad and Dean [2009]; Beeson [2014].

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Focusing on these aspects will show which amongst classical vs. non-classical, and proof theoretical vs. model theoretical approaches are best suited to formally capture Euclid's reasonings. In particular I will argue that:

1. Contemporary proposals often rest on different ideas of 'formal'‡.
2. Many of them prove inadequate to formalize Euclid's geometrical thinking.
3. In the light of new philological evidence, the approaches that seem most promising are the non-classical (constructive) and proof theoretical ones, in that they both seem indispensable to capture the dynamics of Euclid's geometrical reasoning.
4. Ancient mathematics can offer a very interesting context of application and further development for contemporary research in proof theory and constructive mathematics.

Rosalie Iemhoff (Utrecht University, The Netherlands, `http://www.phil.uu.nl/~iemhoff/`, e-mail: R.Iemhoff@uu.nl):
Uniform interpolation and proof systems

In 1992 a paper by Andrew Pitts appeared in which a syntactic method to construct what later became known as uniform interpolants was introduced, for intuitionistic propositional logic. The existence of such uniform interpolants imply the existence of interpolants, but not necessarily vice versa. An example of a modal logic with uniform interpolation was first given by Volodya Shavrukov who showed, by semantic means, that K has this property. Later Silvio Ghilardi proved the same for GL. Intriguingly, S4 has interpolation but not uniform interpolation, also proved by Ghilardi, and the same holds for K4, as shown by Marta Bílková. The latter also showed that Pitts' technique to prove uniform interpolation can be applied to several modal logics as well.

Here we generalise Pitts' method in such a way that having uniform interpolation becomes a property of proof systems rather than of logics. Some general conditions on axioms and rules are formulated so that any proof system satisfying these conditions has uniform interpolation. This has the advantage that many proof systems, and whence logics, can be treated at once. Moreover, from the fact that a logic does not have uniform interpolation it follows that it cannot have a proof system of the above kind. These insights can be applied to several modal and intermediate logics.

‡See Panbuccian [2000]; Dutilh Novaes [2013]

Hidenori Kurokawa (University of Helsinki, `https://helsinki.academia.edu/HidenoriKurokawa`, e-mail: hidenori.kurokawa@gmail.com) and **Sara Negri**: (University of Helsinki, `http://www.helsinki.fi/~negri/`, e-mail: sara.negri@helsinki.fi):

Labelled sequent calculi for substructural logics I: Relevant logics

Substructural logics have been identified as logics obtained by dropping the structural rules of weakening and/or contraction from the sequent calculus for classical logic formulated in a traditional style. Although traditional relevant logics have slightly different formulations from these cases due to the presence of distributive laws, these logics have also been broadly considered to be in the same family of substructural logics as other typical substructural logics (such as linear logic and BCK logic). This is because relevant logics have the common feature that the monotonicity principle $A \to (B \to A)$, an axiomatic counterpart of weakening rule, fails to hold. The family of relevant logics has also been semantically characterized by Routley-Meyer semantics, a relational semantics based on ternary accessibility relations. In this talk, we formulate these traditional relevant logics by using labelled sequent calculi with a ternary relational symbol, analogously to the binary labelled sequent calculi for modal logics in (Negri, 2005). In particular, we develop those calculi for relevant logics by adopting G3-style sequent calculi, which are formulated in such a way that all the rules are invertible and all the structural rules (including cut) are admissible. We highlight the fact that, although relevant logics are usually formulated by omitting the structural rules of weakening and contraction, in the labelled sequent calculi presented in this talk, we can show that all the rules are invertible and the structural rules of weakening and contraction are admissible in a height-preserving manner.

Paolo Maffezioli and **Alberto Naibo** (University of Bologna, Italy, `https://sites.google.com/site/paolomaffezioli/`, e-mail:
paolo.maffezioli@gmail.com;
IHPST, Université Paris 1 Panthéon-Sorbonne, France,
`http://www.ihpst.cnrs.fr/membres/membres-permanents/naibo-alberto`,
e-mail: Alberto.Naibo@univ-paris1.fr):

Proof theory for first-order logic of social choice

In social choice theory, order-theoretic notions have always played an important role in providing a formal representation of individual and collective preferences. Properties such as transitiviy and connectedness as well as majority voting and Pareto optimality can be easily expressed using order relations. Traditionally, such properties are formulated in the language of predicate logic (with or without identity) and presented as axioms of Hilbert-style calculi. Since axiomatic theories make it difficult to analyze the structure of formal derivations and consequently to regiment the proofs in ordinary mathematics, we present a first-order theory of social choice as a calculus based on rules of inference, following the tradition of sequent calculi originated with Genzten. In this way, the standard axioms of social choice are formulated as a rules of inference and it is shown how the structural properties of the system, in particular the admissibility of the rules of cut and contraction, can be preserved. Secondly, such structural properties are used to provide a fully formal reconstruction of well-known results in social choice theory like Arrow's impossibility theorem and Sen's paradox of Paretian liberal.

Sara Negri (University of Helsinki, Finland, `http://www.helsinki.fi/~negri/`, e-mail: sara.negri@helsinki.fi):

Proof theory for neighborhood semantics

The internalization of possible worlds semantics in labelled sequent calculi provides a versatile formalism for the proof-theoretical investigation of large families of philosophical logics. In recent work (Dyckhoff and Negri, *Geometrization of first-order logic*, BSL, in press) it was shown that the method indeed encompasses logics characterized by arbitrary first-order conditions in their Kripke frames. The semantics of important intensional connectives such as Lewis' counterfactual conditionals, as well as the modalities of non-normal systems, however, cannot be captured by standard Kripke semantics and requires the more general neighbourhood semantics, a topological semantics which has had an intensive development since the 1970's. The question arises as to whether the successes of the semantic methods can be matched by equally powerful and general syntactic theories of modal and conditional concepts and reasoning.

In perfect analogy to the method of proof analysis in modal logic based on relational semantics, systems of proof for modal and philosophical logics based on neighborhood semantics are introduced. The procedure follows the standard path of inferentialism, suitably widened to accommodate the topological meaning explanation of the logical constants. In particular, the nesting of quantifiers in the truth conditions for the modalities and other intensional connectives makes the determination of the rules of the calculus an interesting and challenging task. The rules are obtained directly through a conservative extension of the modal language, without exploiting the known translations of the neighborhood semantics into the relational one, and without using non-local rules. For the calculi obtained, admissibility of the structural rules can be established either syntactically, through suitable inductions on the structure of derivations. or semantically, through completeness. The completeness proof, in turn, gives a construction of formal proofs for derivable sequents and countermodels for underivable ones and can be turned into a proof of decidability through saturation and filtration. Case studies include standard non-normal modal logics, deontic logics, and conditionals.

Nicola Olivetti (Aix-Marseille University, France, `http://www.lsis.org/olivetti/`, e-mail: nicola.olivetti@univ-amu.fr):

Internal and External Calculi for conditional logics

The recent history of conditional logics begins with the pioneering works by Lewis, Stalnaker, Nute, Chellas and Burgess, among others, who aimed to formalize a kind of hypothetical reasoning that cannot be captured by material implication of classical logic. Conditional logics have found an interest in epistemology, artificial intelligence and knowledge representation to formalise counterfactual reasoning, this was the original motivation, but also to model belief change (if the agent learns A (s)he will believe/know B), to represent plausible inferences ("in normal circumstances if A then B") and to handle rules with exceptions (nonmomonotonic reasoning).

Semantically, all conditional logics enjoy a possible world semantics, with the intuition that a conditional $A > B$ is true in a world x if B is true in the set of worlds where A is true and that are most similar to/closest to/"as normal as" x. Since there are different ways of formalizing "the set of worlds similar/closest/..." to a given world, there are expectedly different semantics for conditional logics, from the most general selection function semantics to the stronger sphere semantics.

The proof theory of conditional logics is not as developed as the one of other extensions of classical logics, first of all modal logics of which they might be considered a generalisation. We shall present several calculi for conditional logics, following the traditional distinction between external proof systems, which extend the object language by partially importing the semantics, and internal proof systems, where any proof configuration may be directly read as a formula of the object language. In particular we shall present recently introduced nested sequent calculi, a generalisation of Gentzen systems, which seem particularly natural for conditional logics, at least for the basic ones characterised by the selection function semantics. We shall finally discuss some open problems, in particular the challenge of obtaining natural internal calculi for stronger conditional logics, such as Lewis' logics of counterfactuals.

Eugenio Orlandelli (University of Bologna, Italy, `http://www.cis.unibo.it/sth/doc_students/curricula/orlandelli.html`, e-mail: orlandellieugenio@hotmail.com):

Proof theory of non-normal modal logics

In the context of deontic and epistemic logics it is widely recognized that a logic weaker than a normal modal logic should be employed. Non-normal logics are quite well understood from a semantic point of view, where they are studied by means of neighborhood semantics. Their proof theory, nevertheless, is rather limited since it is confined to Hilbert-style axiomatic systems. There have been some work in the area of sequent systems for non-normal modal logics, however the existing sequent calculi for non-normal logics either consider only some limited class of non-normal logics or do not allow to eliminate all the structural rules of inference.

We fill this gap by introducing **G3**-style sequent calculi for the minimal non-normal modal logics **E** and for all its extensions obtained by some combination of the axioms $M, C, N, D, D^{\star}$. For all these calculi we prove that weakening and contraction are height-preserving admissible, and we give a syntactic proof of the admissibility of cut. This yields that the subformula property holds for them and that they are decidable. Then we show that our calculi are equivalent to the axiomatic ones, and therefore that they are sound and complete w.r.t. neighborhood semantics. Finally, we use the well-known Maehara-Takeuti technique to prove Craig's interpolation theorem for non-normal modal logics. In this way we obtain not only a proof of the interpolation theorem, but also an explicit procedure to construct interpolants. Thus we show that in the context of non-normal logics the **G3**-style calculi are extremely well-behaved and allow to give constructive proofs of many deep logical results.

Alessandra Palmigiano (Delft University of Technology, The Netherlands; joint work with Giuseppe Greco, Minghui Ma , Apostolos Tzimoulis, Zhiguang Zhao, `http://www.appliedlogictudelft.nl/giuseppe-greco/`, e-mail:
a.palmigiano@tudelft.nl:)

Unified Correspondence as a Proof-Theoretic Tool

This talk focuses on the formal connections which have recently been highlighted between correspondence phenomena, well known from the area of

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modal logic, and the theory of display calculi originated by Belnap.

These connections have been seminally observed and exploited by Marcus Kracht, in the context of his characterisation of the modal axioms (which he calls primitive formulas) which can be effectively transformed into 'good' structural rules of display calculi. In this context, a rule is 'good' if adding it to a display calculus preserves Belnap's cut-elimination theorem.

In recent years, correspondence theory has been uniformly extended from classical modal logic to diverse families of nonclassical logics, ranging from (bi-)intuitionistic (modal) logics, linear, relevant and other substructural logics, to hybrid logics and mu-calculi. This generalisation has given rise to a theory called unified correspondence, the most important technical tool of which is the algorithm ALBA.

We put ALBA to work to obtain a generalisation of Kracht's transformation procedure from axioms into 'good' rules. This generalisation concerns more than one aspect. Firstly, we define primitive formulas/inequalities in any logic the algebraic semantics of which is based on distributive lattices with operators. Secondly, in the context of each such logic, we significantly generalise the class of primitive formulas/inequalities, and we apply ALBA to obtain an effective transformation procedure for each member of this class.

Heinrich Wansing (Ruhr-University Bochum Germany,
`http://www.ruhr-uni-bochum.de/philosophy/logic/`,
e-mail: Heinrich.Wansing@rub.de):

Natural deduction for bi-connexive logic

Both bi-intuitionistic logic and connexive logic have received considerable attention recently, see, for example, (Goré 2000), (McCall 2012), (Wansing 2014). A bi-intuitionistic system, 2Int, different form the bi-intuitionistic logic BiInt that is also know as Heyting-Brouwer logic, has been introduced in (Wansing 2013). In this talk I will present a natural deduction proof system for a connexive version of 2Int. It combines the use of proofs as well as dual roofs with a connexive interpretation of the implication and co-implication connectives of 2Int. Moreover, a formulas-as- types notion of construction is presented for the co-negation, implication, and co-implication fragment of 2Int. This construction makes use of a two-sorted typed lambda calculus.

References

Goré, R., "Dual intuitionistic logic revisited", in: R. Dyckhoff (ed.), *Automated Reasoning with AnalyticTableaux and Related Methods*, Springer Lecture Notes in AI 1847, Springer, 2000, 252–67.

McCall, S., "A History of Connexivity", in D.M. Gabbay et al. (eds.), *Handbook of the History of Logic. Volume 11. Logic: A History of its Central Concepts*, Amsterdam, Elsevier, 2012, 415–449.

Wansing, H., "Falsification, natural deduction, and bi-intuitionistic logic", *Journal of Logic and Computation*, published online July 2013, doi:10.1093/logcom/ext035.

Wansing, H., "Connexive Logic", *The Stanford Encyclopedia of Philosophy* (Fall 2014 Edition), Edward N. Zalta (ed.), URL =<http://plato.stanford.edu/archives/fall2014/entries/logic- connexive/>.

3 Preliminary schedule

9.00–10.30 CLMPS plenary lecture

10.30–11.00 break

11.00–11.30 Avron: *Using Assumptions in Gentzen-type Systems*

11.30–12.00 Iemhoff: *Uniform interpolation and proof systems*

12.00–12.30 Wansing: *Natural deduction for bi-connexive logic*

12.30–13.00 Genco: *Mimamsa deontic logic: proof theory and applications*

13.00–14.30 lunch

14.30–15.00 Palmigiano: *Unified Correspondence as a Proof-Theoretic Tool*

15.00–15.30 Graziani: *Proof theory for non-classical Euclid's geometrical logic*

15.30–16.00 Maffezioli: *Proof theory for first-order logic of social choice*

16.00–16.30 Orlandelli: *Proof theory of non-normal modal logics*

16.30–17.00 break

17.00–17.30 Olivetti: *Internal and External Calculi for conditional logics*

17.30–18.00 Kurokawa: *Labelled sequent calculi for substructural logics I: Relevant logics*

18.00–18.30 Negri: *Proof theory for neighborhood semantics*

LOGIC COLLOQUIUM

LC 2015 PROGRAMME

MONDAY 3 AUGUST

8.30AM–10.30AM

Registration

You will find the conference registration and information desk on the ground floor of Porthania (Yliopistonkatu 3).

The registration desk accepts ONLY CASH PAYMENTS. If you need to pay your registration fee or some other conference services by cash, please bring with you the exact sum.

Venue - Porthania Lobby

10.30AM–12.00PM

Special Session on Set Theory

Reflection and antireflection at the successor of a singular cardinal
Laura Fontanella, Hebrew University of Jerusalem Einstein Institut of Mathematics, ISRAEL

Condensation does not imply Square
Peter Holy, University of Bonn, GERMANY

Venue – PII

10.30AM–12.00PM

Special Session on Proof Theory

Transfinite reflection principles and subsystems of second-order arithmetic
David Fernández Duque, Instituto Tecnológico Autónomo de México

Atomic polymorphism: an overview
Gilda Ferreira, Faculdade de Ciências - Universidade de Lisboa, PORTUGAL

Venue - PIII

10.30AM–12.00PM

Special Session on Logic and Quantum Foundations

Quantum Team Logic and Bell's Inequalities
Gianluca Paolini
University of Helsinki, FINLAND

Strong Complementarity and Non-Locality
Ross Duncan, University of Strathclyde, UNITED KINGDOM

Venue - PIV

12.05PM–1.05PM

Tutorial 1.1

On the Set Theory of Generalized Logics
Menachem Magidor
Einstein Institute of Mathematics, Hebrew University of Jerusalem, ISRAEL

Venue – PI

1.05PM–2.30PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with CLMPS 2015) for participants who have purchased the additional lunch package.

If you have not purchased the lunch packege online while registering, please ask for lunch packages at the registration desk.

Venue - Main Building Unicafe

2.30PM–4.30PM

Opening Ceremony

The opening ceremony is also open for avecs!

The program includes welcome addresses by CLMPS 2015 and LC 2015 organizers and organizing institutions. The Classic University Choir, YL double quartet, will perform best pieces of their reportoire.

Venue - Great Hall, Main Building,

4.30PM–5.00PM

Coffee

Venue - Great Hall Foyers, Main Building,

5.00PM–6.30PM

Plenary Lecture: Johan van Benthem

Logic in Play
Johan van Benthem,
Amsterdam, Stanford and Tsinghua University,

Venue - Great Hall, Main Building

6.30PM–8.00PM

University Reception

The Rector of the University of Helsinki welcomes the colloquium participants by treating them to a wine and salad buffet after the first colloquium-opening day.

The number of participants at the University Reception is **limited.** The earlier you register for LC2015, the more likely you can participate in the University Reception.

The reception is also open for avecs!

Venue - University Main Building (Fabianinkatu 33), Press Hall Foyer.

TUESDAY 4 AUGUST

9.00AM–10.00AM

Plenary Lecture: Artem Chernikov

Applications of model theory in extremal graph combinatorics
Artem Chernikov, Institut de Mathématiques de Jussieu - Paris Rive Gauche, FRANCE

Venue - PI

10.00AM–10.30AM

Coffee

Venue - Porthania Lobby

10.30AM–11.30AM

Tutorial 1.2

On the Set Theory of Generalized Logics
Menachem Magidor
Einstein Institute of Mathematics, Hebrew University of Jerusalem, ISRAEL

Venue – PI

11.30AM-12.35 PM

Break

12.35PM–2.00PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with CLMPS 2015) for participants who have purchased the additional lunch package.

Venue - Main Building Unicafe

2.00PM–3.30PM

Special Session on Set Theory

Dynamics of the homeomorphism group of the Lelek fan
Aleksandra Kwiatkowska
University of Bonn, GERMANY
Dana Bartosova
University of Sao Paulo, BRAZIL

Forcing and generic absoluteness without choice
Philipp Schlicht
Universität Münster, GERMANY

Venue - PII

2.00PM–3.30PM

Special Session on Proof Theory

Provability. Explicit proofs. Reflection.
Elena Nogina
BMCC, City University of New York, UNITED STATES

Proof-theoretic Approach to Craig Interpolation
Roman Kuznets
TU Wien, AUSTRIA

Venue - PIII

2.00PM–3.30PM

Special Session on Logic and Quantum Foundations

Entropy and Simulation of No-Signaling Models
Adam Brandenburger (NYU)

Reasoning about Classical and Quantum Interaction
Sonja Smets
Amsterdam

Venue - PIV

3.30PM–4.00PM

Coffee

Venue - Porthania Lobby

4.00PM–6.00PM

Contributed Talks 1

Applications of motivic integration to the fundamental lemma
Jorge Cely
University of Pittsburgh, UNITED STATES

Correlations between HS-derivations and the SCF_{p,e}
Daniel Hoffmann
Wroclaw University, POLAND

On orthogonality of a family of convex components of a type in weakly circularly minimal structures
Aizhan Altayeva
Institute of Mathematics and Mathematical Modelling, KAZAKHSTAN
Beibut Kulpeshov
International Information Technology University, KAZAKHSTAN

”Generic” functions over divisible ordered abelian groups
Alfred Dolich
Kingsborough Community College and the CUNY Grad Center, UNITED STATES

Robinson’s property and amalgamations of higher arities
David Nyiri
Budapest University of Technology and Economics, HUNGARY

On algebras of distributions for binary formulas of countably categorical weakly o-minimal theories

Beibut Kulpeshov
International Information Technology University, Almaty, KAZAKHSTAN
Institute of Mathematics and Mathematical Modeling, Almaty, KAZAKHSTAN

Sergey Sudoplatov
Sobolev Institute of Mathematics, Novosibirsk, RUSSIAN FEDERATION
Novosibirsk State Technical University, Novosibirsk, RUSSIAN FEDERATION
Novosibirsk State University, Novosibirsk, RUSSIA FEDERATION
Institute of Mathematics and Mathematical Modeling, Almaty, KAZAKHSTAN

Dmitriy Yemelyanov
Novosibirsk State University, Novosibirsk, RUSSIA
Institute of Mathematics and Mathematical Modeling, Almaty, KAZAKHSTAN

Venue - PI

4.00PM–6.00PM

Contributed Talks 2

Confluence of cut elimination with respect to Herbrand disjunctions
Bahareh Afshari
TU Wien, AUSTRIA
Stefan Hetzl
Vienna University of Technology, AUSTRIA
Graham Leigh
Vienna University of Technology, AUSTRIA

Gentzen’s ordinal collapsing function
Annika Siders
University of Helsinki, FINLAND

Constructive completeness and non-discrete languages
Henrik Forssell
Stockholm University, SWEDEN

A Uniform Idea behind Gentzen's Three Consistency Proofs
Ryota Akiyoshi
Waseda Institute for Advanced Study, JAPAN
Yuta Takahashi
Keio University, JAPAN

Some partial conservativity properties for Intuitionistic Set Theory with the principle P.
Alexey Vladimirov
Moscow State University, Dept. of Mathematics and Mechanics

Venue - PII

4.00PM–6.00PM

Contributed Talks 3

Large cardinals and the ordinal topological completeness of GLP
Joan Bagaria,
ICREA and Universitat de Barcelona, SPAIN

Forcing, regularity properties and the axiom of choice
Haim Horowitz
Hebrew university of Jerusalem, ISRAEL
Saharon Shelah
Hebrew university of Jerusalem, ISRAEL

A generalisation of closed unbounded sets
Hazel Brickhill
University of Bristol, UNITED KINGDOM

Initial segments of models of set theory defined by non-trivial automorphisms
Zachiri McKenzie
University of Gothenburg, SWEDEN

On thin-tall and thin-thick Boolean spaces
Juan Carlos Martínez
University of Barcelona, SPAIN

Some applications of finite-support products of Jensen's minimal $\varDelta^1_3$ forcing
Vladimir Kanovei
IITP, RUSSIAN FEDERATION

Venue - PIII

4.00PM–6.00PM

Contributed Talks 4

Yablo's Paradox(es) as Theorem(s) in Temporal Logic
Ahmad Karimi
Behbahan Khatam Alanbia University of Technology, IRAN

Lockean danger zones and lossy inferences
Ted Shear
University of California, Davis, UNITED STATE

Towards a Formal Occurrence Logic based on Predicate Logic
Farshad Badie
Aalborg University, DENMARK
Hans Götzsche
Aalborg University, DENMARK

Epistemic logics for sceptical agents
Marta Bilkova
Institute of Computer Science, Academy of Sciences of the Czech Republic, CZECH REPUBLIC
Ondrej Majer
Institute of Philosophy, Academy of Sciences of the Czech Republic, CZECH REPUBLIC

Categories of first order quantifiers
Urszula Wybraniec-Skardowska
Group of Logic, Language and Information, POLAND

Quantum states by first order variables: some consequences
Giulia Battilotti
Dept. of Mathematics, University of Padova, ITALY

Venue - PIV

4.00PM–6.00PM

Contributed Talks 5

A formalization of Gödelian causal theory
Srecko Kovac
Institute of Philosophy, A public research institute, Zagreb, CROATIA

Gödel's philosophy of mathematics and structural realism about empirical sciences
Julia Jankowska
University of Warsaw, POLAND

Axiomatization of Renaissance Geometry
Ryszard Mirek
Pedagogical University of Krakow, POLAND

A Generalization of the Cantor-Dedekind Continuum
Jose Roquette
Tecnico-Universidade de Lisboa, PORTUGAL

Lingua characterica and calculus ratiocinator: the polemic between Frege and Schröder
Joan Bertran-San Millán
Universitat de Barcelona, SPAIN

Axiomatic metatheory: A Fregean perspective on independence proofs
Günther Eder
Department of Philosophy, University of Vienna, AUSTRIA

Venue - P617

4.00PM–6.00PM

Contributed Talks 6

On language fragments of propositional fuzzy logics
Zuzana Hanikova
Institute of Computer Science, Academy of Sciences of the Czech Republic, CZECH REPUBLIC

Basic set-theoretical notions over fuzzy partial logic
Martina Dankova
IRAFM, University of Ostrava, CZECH REPUBLIC

Towards fuzzy partial logic of the first and higher orders
Libor Behounek
Institute for Research and Applications of Fuzzy Modeling, University of Ostrava, NSC IT4Innovations, CZECH REPUBLIC

Codensity and Stone spaces
Andrei Sipos
Institute of Mathematics of the Romanian Academy, ROMANIA

Completeness theorem for first-order algebraizable logics
Petr Cintula
Institute of Computer Science, Czech Academy of Sciences, CZECH REPUBLIC
Carles Noguera
Institute of Information Theory and Automation, Czech Academy of Sciences, CZECH REPUBLIC

Godel's incompleteness property for a decidable fragment of arrow logic
Mohamed Khaled
Central European University, HUNGARY

Venue - P673

4.00PM–6.00PM

Contributed Talks 7

The expressive power of modal inclusion logic
Lauri Hella
University of Tampere, FINLAND
Johanna Stumpf
TU Darmstadt, GERMANY

Dimension theory for modal logics
Kerkko Luosto
University of Helsinki, FINLAND

A maximal semantics for dependence logic
Fredrik Engström
University of Gothenburg, SWEDEN

Defining properties of teams in k-ary inclusion-exclusion logic
Raine Rönnholm
University of Tampere, FINLAND

Some proof theoretical results on propositional logics of dependence
Rosalie Iemhoff
Utrecht University, NETHERLANDS
Fan Yang
Utrecht University, NETHERLANDS

Definability in modal logics with team semantics
Jonni Virtema
Leibniz Universität Hannover, GERMANY

Venue - P674

4.00PM–6.00PM

Contributed Talks 8

Degree spectra of real closed fields
Russell Miller
Queens College and The Graduate Center – CUNY, UNITED STATES
Victor Ocasio Gonzalez
University of Puerto Rico at Mayaguez, UNITES STATES

Degrees of autostability for prime Boolean algebras
Margarita Marchuk
Sobolev Institute of Mathematics, RUSSIAN FEDERATION
Nikolay Bazhenov
Sobolev Institute of Mathematics, RUSSIAN FEDERATION

Effective categoricity on computable linear orderings
Andrey Frolov
Kazan Federal University, RUSSIAN FEDERATION

The theory of projective planes is complete with respect to degree spectra and effective dimensions
Nurlan Kogabaev
Sobolev Institute of Mathematics, RUSSIAN FEDERATION

Computable linear orders with some natural relations
Ravil Bikmukhametov
Kazan Federal University, RUSSIAN FEDERATION

Venue - P722

4.00PM–6.00PM

Contributed Talks 9

Autostability relative to strong constructivizations of computable structures of nontrivial language
Margarita Marchuk
Sobolev Institute of Mathematics, RUSSIAN FEDERATION

Flexible formulae and partial conservativity
Rasmus Blanck
University of Gothenburg, SWEDEN

Suppes-style rules for probability logic
Marija Boricic
Faculty of Organizational Sciences, University of Belgrade, SERBIA

A hierarchy of uniformities between Medvedev and Muchnik reducibility
Rutger Kuyper
Radboud University Nijmegen, NETHERLANDS

Universality, optimality, and randomness deficiency
Paul Shafer
Department of Mathematics, Ghent University, BELGIUM
Rupert Hölzl
National University of Singapore, SINGAPORE

On the Δ_0 induction for the compositional truth predicate
Mateusz Łełyk
University of Warsaw, POLAND
Bartosz Wcisło
University of Warsaw, POLAND

Venue - P723

4.00PM–6.00PM

Contributed Talks 10

Nonstandard analysis approach to the mathematical foundations of quantum mechanics
Evgeny Gordon
Eastern Illinois University, UNITED STATES
Pavol Zlatos
Comenius University, SLOVAKIA

Contextuality, cohomology and paradox
Samson Abramsky
Oxford University, UNITED KINGDOM
Kohei Kishida
Oxford University, UNITED KINGDOM
Raymond Lal
Oxford University, UNITED KINGDOM
Shane Mansfield
Oxford University, UNITED KINGDOM
Rui Soares Barbosa
Oxford University, UNITED KINGDOM

A typed λ-calculus approach to photon polarization in quantum mechanics.
M.A. Nait Abdallah
UWO, LONDON, CANADA
INRIA, Rocquencourt, FRANCE

Temporal Logics for Continuous Collaborative Games
Farn Wang
National Taiwan University, TAIWAN

Homotopy Model Theory
Brice Halimi
Department of Philosophy, University Paris Ouest Nanterre La Défense. FRANCE

Demuth's path to randomness
Antonin Kucera
Charles University, CZECH REBUBLIC

Venue - P724

6.10PM

Conference photo

Venue - In Front of Porthania

7.30PM–9.30PM

City Visit

SOLD OUT! Ask for last minute cancellations at the registration desk

Starting point: Senate Square, next to Main Building

Price: 15 €

Choose either Helsinki City Walk or Helsinki Bus Tour

Venue - Senate Square, next to Main Building

WEDNESDAY 5 AUGUST

9.00AM–10.00AM

Plenary Lecture: Danielle Macbeth

Logical Form, Mathematical Practice, and Frege's Begriffsschrift
Danielle Macbeth
Haverford College, UNITED KINGDOM

Venue - PI

10.00AM–10.30AM

Coffee

Venue - Porthania Lobby

10.30AM–11.30AM

Tutorial 1.3

On the Set Theory of Generalized Logics
Menachem Magidor
Einstein Institute of Mathematics, Hebrew University of Jerusalem, ISRAEL

Venue – PI

11.35AM – 1.05PM

Special Session on Model Theory

Non-forking formulas in distal NIP theories
Gareth Boxall
Stellenbosch University, SOUTH AFRICA
Charlotte Kestner
University of Leeds, UNITED KINGDOM

Simple homogeneous structures
Vera Koponen
Uppsala University, SWEDEN

Venue - PII

11.35AM–1.05PM

Special Session on Computability Theory

The Strength of Turing Determinacy within Second Order Arithmetic
Richard Shore
Cornell University, UNITED STATES

Computable, uniform, and strong reductions
Damir Dzhafarov
University of Connecticut, UNITED STATES

Venue - PIII

11.35AM–1.05PM

Special Session on Philosophy of Mathematics and Logic

Mathematical depth and Szemeredi's theorem
Andrew Arana
University of Illinois at Urbana-Champaign, UNITED STATES

Logic and Invariance: take a step back, look at the bigger picture and devour the whale (one bit a time)
Denis Bonnay
Paris Ouest University – IHPST, FRANCE

Venue - PIV

LC 2015 PROGRAMME – WEDNESDAY 5 AUGUST

1:05AM–2:30PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with CLMPS 2015) for participants who have purchased the additional lunch package.

Venue - Main Building Unicafe

2.30PM–3.30PM

Plenary Lecture: Kobi Peterzil

Topological groups and stabilizers of types (joint work with S. Starchenko)
Kobi Peterzil
University of Haifa, ISRAEL

Venue - PI

3.30PM–4.00PM

Coffee

Venue - Porthania Lobby

4.00PM–6.00PM

Contributed Talks 11

Fields in Zariski-like structures
Kaisa Kangas
University of Helsinki, FINLAND

On near model completeness of generic structures
Koichiro Ikeda
Hosei University, JAPAN

Generalised stability of pseudofinite residue rings
Ricardo Bello Aguirre
University of Leeds, UNITED KINGDOM

Investigating an unstable generic structure
Ali Valizadeh
Amirkabir University of Technology, IRAN
Massoud Pourmahdian
Amirkabir University of Technology, IRAN

Some dynamical approaches to NIP theories
Alireza Mofidi
Amirkabir University of Technology and IPM, IRAN

Venue - PI

4.00PM–6.00PM

Contributed Talks 12

Parametric polymorphism and the completeness of type theory
Paolo Pistone
Università Roma Tre, ITALY

Types and operations
Stanislaw Ambroszkiewicz
Institute of Coputer Science, Polish Academy of Sciences, POLAND

On some universal system for various propositional logics.
Anahit Chubaryan
Yerevan State University, ARMENIA
Armine Chubaryan
Yerevan State University, ARMENIA
Hakob Nalbandyan
Yerevan State University, ARMENIA
Sergey Sayadyan
Yarevan, ARMENIA

Arithmetical Conservation Results and Goodman's Theorem
Benno van den Berg
ILLC, University of Amsterdam, NETHERLANDS

Reverse mathematical bounds for the Termination Theorem
Stefano Berardi
University of Torino, ITALY
Silvia Steila
Dipartimento di Informatica, Università degli studi di Torino, ITALY
Keita Yokoyama
School of Information Science, Japan Advanced Institute of Science and Technology, JAPAN

Completeness of the Universal Hybrid Calculus
Bill Wadge
University of Victoria, CANADA
Omar Alaqeeli
University of Victoria, CANADA

Venue - PII

4.00PM–6.00PM

Contributed Talks 13

Class-Forcing in Class Theory
Carolin Antos
Kurt Gödel Research Center, University of Vienna, AUSTRIA

On the relationship between proper classes and forcing extensions
Neil Barton
Birkbeck College, University of London, UNITED KINGDOM

A theory of truth equi-consistent with Quine's New Foundations
Graham Leigh
Vienna University of Technology, AUSTRIA

Completeness of infinitary intuitionistic logics
Christian Espindola
Stockholm University, SWEDEN

On the naturalness of Forcing Axioms
Giorgio Venturi
Unicamp, ITALY

Sets and Set Theoretic Foundations
Mark Addis
Birmingham City University, UNITED KINGDOM

Venue - PIII

4.00PM–6.00PM

Contributed Talks 14

Unifying Logic and Boolean Algebra
Joachim Mueller-Theys
Private, GERMANY

Some infinitary paradoxes and undecidable sentences in Peano arithmetic
Ka Yue Cheng
Eötvös Loránd University, HUNGARY

Peano arithmetic can well prove its own consistency
Alexandr Bessonov
Institute of Philosophy and Law, Siberian Branch, Russian Academy of Sciences, Novosibirsk State University, RUSSIAN FEDERATION

Distributive normal forms 2015
Jaakko Hintikka
University of Helsinki, FINLAND

Three kinds of mathematical naturalness
Benedict Eastaugh
University of Bristol, UNITED KINGDOM

Varieties of Ramified-Type Assignment Systems
Harold Hodes
Cornell University, UNITED STATES

Venue - P617

4.00PM–6.00PM

Contributed Talks 15

First steps towards justification logic
Ioannis Kokkinis
Universität Bern, SWITZERLAND

A relational doxastic logic
Thomas Benda
National Yang Ming University, TAIWAN

Big Brother Logic: visual-epistemic reasoning in multi-agent systems
Olivier Gasquet
IRIT, UPS, FRANCE
Valentin Goranko
Stockholm University, SWEDEN
Francois Schwarzentruber
École normale supérieure de Rennes, SWEDEN

Effects in Modal Logics
Alexandre Madeira
HasLab - INESC TEC & Minho University, PORTUGAL
Renato Neves
HasLab - INESC TEC & Minho University, PORTUGAL
Manuel A. Martins
University of Aveiro, PORTUGAL
Luis Barbosa
Universidade do Minho, PORTUGAL

On first-order temporal logics of spacetimes
Attila Molnár
ELTE, HUNGARY

Venue - P673

4.00PM–6.00PM

Contributed Talks 16

Application of Jump inversion for structures in the context of omega-enumeration reducibilities
Alexandra Soskova
Sofia University, BULGARIA
Stefan Vatev
Sofia University, BULGARIA

Complexity of Orders on Groups
Valentina Harizanov
George Washington University, UNITED STATES

Lowness for isomorphism as restricted to classes of structures
Jacob Suggs
University of Connecticut, UNITED STATES

Algorithmic complexity of orders of groups
Jennifer Chubb
University of San Francisco, UNITED STATES
Mieczyslaw Dabkowski
University of Texas, Dallas, UNITED STATES
Valentina Harizanov
George Washington University, UNITED STATES

Local computability and hereditarily finite superstructures
Svetlana Aleksandrova
Novosibirsk State University, RUSSIAN FEDERATION
Nikolay Bazhenov
Sobolev Institute of Mathematics, Novosibirsk State University, RUSSIAN FEDERATION

Generalizing Godel's and Rosser's incompleteness theorems for nonrecursively enumerable theories
Payam Seraji
University of Tabriz, IRAN
Saeed Salehi
Tabriz university, IRAN

Venue - P722

4.00PM–6.00PM

Contributed Talks 17

There are no minimal pairs in $L[{\bf d}]$
Mars Yamaleev
Kazan Federal University, RUSSIAN FEDERATION

Universal enumerations of families and hyperimmunity
Marat Faizrahmanov
Kazan (Volga Region) Federal University, RUSSIAN FEDERATION

Degree spectra of n-families
Marat Faizrahmanov
Kazan Federal University, RUSSIAN FEDERATION
Iskander Kalimullin
Kazan Federal University, RUSSIAN FEDERATION

On limitwise monotonic reducibility of sets and sequences
Damir Zainetdinov
Kazan Federal University, RUSSIAN FEDERATION

Definability in the local theory of the ω-Turing degrees
Andrey Sariev
Sofia University, BULGARIA

Hierarchies of n-r.e. sets in every non-zero r.e. degree
Dariusz Kalociński
Institute of Philosophy, University of Warsaw, POLAND

Venue - P723

6.30PM–9.00PM

City Hall Reception

The City of Helsinki hosts a welcome reception for the colloquium quests at the heart of the historic centre next to the sea-side Market Square. After a welcome speech by a city representative, the guests have a chance to enjoy a light buffet dinner and the architecture of the City Hall.

Venue: City Hall, Pohjoisesplanadi 11-13

THURSDAY 6 AUGUST

9.00AM–10.30AM

Plenary Lecture: Steve Awodey

Cubical homotopy type theory and univalence
Steve Awodey
Carnegie Mellon University, UNITED STATES

Venue - PI

10.30AM–11.00AM

Coffee

Venue - Porthania Lobby

11.00AM–12.00PM

Tutorial 2.1

Dependence and Independence in Logic
Erich Grädel
RWTH Aachen, GERMANY

PI

12.05 PM-01.05 PM

Plenary Lecture: Sebastiaan Terwijn

Probability Logic
Sebastiaan Terwijn
Radboud University Nijmegen, NETHERLANDS

Venue - PI

1.05PM–2.30PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with CLMPS 2015) for participants who have purchased the additional lunch package.

Venue - Main Building Unicafe

2.30PM–7.30PM

Excursion to Suomenlinna

Start place: Kauppatori harbour
Price: 70 €

The cruise operator Stromma organizes a special LC 2015 cruise to the Unesco World Heritage site, the Suomenlinna fortress island. The price includes a cruise to Suomenlinna and back on the ship M/S Aava, a guided tour on Suomenlinna, and a light on-board cruise dinner on the way back.

Programme:

14.30 M/S Aava departs from Kauppatori Market Square
14.45 Guided walk on Suomenlinna (1,5 hours)
16.15 Cruise and light dinner on board
19.30 M/S Aava arrives at Kauppatori Market Square

Start venue - Kauppatori

FRIDAY 7 AUGUST

9.00AM–10.00AM

Plenary Lecture: Toshiyasu Arai

Proof theory of set theories
Toshiyasu Arai
Chiba University, JAPAN

Venue - PI

10.00AM–10.30AM

Coffee

Venue - Porthania Lobby

10.30AM–11.30AM

Tutorial 2.2

Dependence and Independence in Logic
Erich Grädel
RWTH Aachen, GERMANY

PI

11.35PM–12.35PM

Plenary Lecture: Ralf Schindler

Martin's Maximum, Woodin's (*), or both?
Ralf Schindler
Institut für mathematische Logik und Grundlagenforschung, Fachbereich Mathematik und Informatik, Universität Münster, GERMANY

Venue - PI

12.35PM–2.00PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with CLMPS 2015) for participants who have purchased the additional lunch package.

Venue - Main Building Unicafe

2.00PM–3.30PM

Special Session on Model Theory

The field of p-adic numbers with a predicate for the powers of a natural number
Nathanaël Mauriaule
Napoli

Imaginaries and definable types in valued differential fields
Silvain Rideau
École normale supérieure, Paris, FRANCE

Venue - PII

2.00PM–3.30PM

Special Session on Computability Theory

Bounded low and high sets
Bernard Andersson
Gordon State College, UNITED STATES
Barbara Csima
University of Waterloo, CANADA
Karen Lange
Wellesley College, UNITED STATES

Computability-theoretic categoricity at levels 1 and 2
Ekaterina Fokina
Kurt Goedel Research Center, AUSTRIA

Venue - PIII

2.00PM–3.30PM

Special Session on Philosophy of Mathematics and Logic

Towards an understanding of mathematical understanding'
Janet Folina
Macalester College, USA

Instrumental nominalism about set-theoretic structuralism
Richard Pettigrew
University of Bristol, UNITED KINGDOM

Venue - PIV

3.30PM–4.00PM

Coffee

Venue - Porthania Lobby

4.00PM–6.00PM

Contributed Talks 18

Cellular objects and Shelah's singular compactness theorem
Tibor Beke
University of Massachusetts Lowell, UNITED STATES
Jiri Rosicky, Masaryk University Brno, CZECH REPUBLIC

Locally projective modules and large cardinals
Juan Nido
Universidad Autónoma de la Ciudad de México, MEXICO
Gabriel Salazar
Institute of Mathematics, Polish Academy of Sciences, POLAND
Luis Villegas
Universidad Autónoma Metropolitana, MEXICO

Topological dynamics and invariant equivalence relations
Tomasz Rzepecki
Uniwersytet Wrocławski, POLAND

Around the set-theoretical consistency of d- tameness of metric abstract elementary classes
Pedro Zambrano
Universidad Nacional de Colombia, COLOMBIA
Will Boney
University of Illinois at Chicago, UNITED STATES

On weakly generic automorphisms of homogeneous structures
Gabor Sagi
Alfred Renyi Institute of Mathematics, HUNGARY

Metric AECs as accessible categories
Michael Lieberman
Masaryk University, CZECH REPUBLIC
Jiri Rosicky
Masaryk University, CZECH REPUBLIC

Venue – PI

4.00PM–6.00PM

Contributed Talks 19

Some applications of dependently sorted logic in constructive mathematics
Erik Palmgren
Stockholm University, SWEDEN

Justifying path induction
Patrick Walsh
Carnegie Mellon University, UNITED STATES

Admissiblility of the structural rules in Kanger's sequent calculus for first order logic with equality
Franco Parlamento
Universita' di Udine, ITALY
Federico Munini
Universita' di Udine, ITALY

Rosser-type Henkin sentences and local reflection principles
Taishi Kurahashi
Kisarazu National College of Technology, JAPAN

Uniform interpolation in weak Grzegorczyk logic and G\"odel-L\"ob logic
Majid Alizadeh
University of Tehran, IRAN
Farzaneh Derakhshan
University of Tehran, IRAN
Hiroakira Ono
Japan Advanced Institute of Science and Technology, JAPAN

A simplification of the Theory of Constructions
Walter Dean
University of Warwick, UNITED KINGDOM
Hidenori Kurokawa
Kobe University, JAPAN

Venue – PII

4.00PM–6.00PM

Contributed Talks 20

A dichotomy theorem for the generalized Baire space and elementary embeddability at uncountable cardinals
Dorottya Sziraki
Central European University, Department of Mathematics, HUNGARY
Jouko Vaananen
University of Helsinki, FINLAND
University of Amsterdam, THE NETHERLANDS

Wadge hierarchy of differences of coanalytic sets
Kevin Fournier
UNIL - PARIS VII, SWITZERLAND

A general extension theorem for complete partial orders
Daniel Wessel
University of Trento, ITALY
Peter Schuster
University of Verona, ITALY

On the topological complexity of the density sets of the real line
Gemma Carotenuto
Università di Salerno, ITALY

On equivalence relations generated by Schauder bases
Longyun Ding
Nankai University, CHINA

Regularity properties on the generalized reals
Yurii Khomskii
University of Hamburg, GERMANY

Venue - PIII

4.00PM–6.00PM

Contributed Talks 21

Computational Complexity of Barwise's Sentence and Similar Natural Language Constructions
Michał Tomasz Godziszewski
University of Warsaw, POLAND
Dariusz Kalociński.
Institute of Philosophy, University of Warsaw, POLAND

Inside the second level of the Mostowski-index hierarchy of the μ-calculus
Jacques Duparc
University of Lausanne, SWITZERLAND
Alessandro Facchini
IDSIA, SWITZERLAND
Kevin Fournier
UNIL - PARIS VII, SWITZERLAND
Henryk Michalewski
Faculty of Mathematics, Informatics and Mechanics, University of Warsaw, POLAND

A note on descriptive complexity of k-SUM
Luis Henrique Bustamante
UFC, BRAZIL
Ana Teresa Martins
Universidade Federal do Cear, BRAZIL

Some notes about lower bounds for steps and sizes of proofs in Frege systems.
Anahit Chubaryan
Yerevan State University, ARMENIA
Armine Chubaryan
Yerevan State University, ARMENIA
Arman Tshitoyan
Yerevan State University, ARMENIA

Asynchronous automata transformations of prefix decidable and Buchi decidable infinite words
Natalia Korneeva
Kazan (Volga Region) Federal University, RUSSIAN FEDERATION

Transfinite graded Turing progressions and modal logic
Eduardo Hermo Reyes
University of Barcelona, SPAIN
Joost J. Joosten
University of Barcelona, SPAIN

Venue - PIV

4.00PM–6.00PM

Contributed Talks 22

Leon Chwistek's Rational Semantics and Contemporary Computation
Hubert Bożek
Pedagogical University of Cracow, POLAND

The Logic of Algorithmic Knowledge
Dariusz Surowik
University of Bialystok, POLAND

Hard and soft logical information
Patrick Allo
Vrije Universiteit Brussel, BELGIUM

Default and non-monotonic spatial reasoning
Przemysław Wałęga
University of Warsaw, POLAND

On the lattice structure of generic common knowledge fixed points
Evangelia Antonakos
Bronx Community College, CUNY, UNITED STATES

Hypercomplex numbers for the semantics of self-reference statements
Vladimir Stepanov
Dorodnicyn Computing Centre of RAS, RUSSIAN FEDERATION

Venue - P617

4.00PM–6.00PM

Contributed Talks 23

A nonstandard model for an ill-posed parabolic equation
Emanuele Bottazzi
University of Trento, ITALY

Communism and the incentive to share in science
Remco Heesen
Carnegie Mellon University, UNITED STATES

Finitisations of second order principles
Florian Pelupessy
Tohoku University, JAPAN

Some Conceptual Hypotheses on Information Entropy, Chaos and Implicit Contradictions.
Antonio Vincenzi
ASFPG, ITALY

A Knowledge First Epistemic Logic of Knowledge and Belief
Syraya Chin-Mu Yang
National Taiwan University, TAIWAN

Venue - P673

4.00PM–6.00PM

Contributed Talks 24

Continuous vs Discrete
Evgeny Gordon
Eastern Illinois University, UNITED STATES

Exact Numerals as Vague Quantifiers
Paula Quinon
Department of Philosophy, Lund University, SWEDEN
Karolina Krzyżanowska
Munich Center For Mathematical Philosophy, GERMANY

Is Separativity an Additional Constraint?
Ranjan Mukhopadhyay
Visva-Bharati, INDIA

Librationist Capture and Domination of Definable Real Numbers
Frode Bjørdal
The University of Oslo, NORWAY

The World of Logic
Jan Wolenski
WSIZ Rzeszow, UJ Krakow, POLAND

Round squares are no contradictions
Jean-Yves Beziau
UFRJ, BRAZIL
UCSD, UNITED STATES

Venue - P674

4.00PM–6.00PM

Contributed Talks 25

Universal binary relations, preorders, and graphs
Luca San Mauro
Scuola Normale Superiore, ITALY

Computable numberings of partial computable functionals
Sergey Ospichev
Novosibirsk State University, RUSSIAN FEDERATION
Sobolev institute of mathematics, RUSSIAN FEDERATION

Reductions between Types of Numberings
Manat Mustafa
Department of Mathematics of School of Science and Technology (SST), Nazarbayev University, KAZAKHSTAN

A-computable numberings of the families of total functions
Assylbek Issakhov
Al-Farabi Kazakh National University, KAZAKHSTAN

Formalization of Ontology and its Algorithmic Properties
Jamalbek Tussupov
Eurasian National University, KAZAKHSTAN
Madina Sambetbaeva
Eurasian National University, KAZAKHSTAN

Some new definability and complexity results in monadic second-order arithmetic
Stanislav Speranski
Sobolev Institute of Mathematics, RUSSIAN FEDERATION

Venue - P722

4.00PM–6.00PM

Contributed Talks 26

Heyting duality as an application of fundamental categorical duality theorem
Mustafa Demirci
Akdeniz University, TURKEY

Effective representation in point-free theories
Vladislav Nenchev
Sofia University “St. Kliment Ohridski”, BULGARIA

Suppes-style rules for probability logic
Marija Boricic
Faculty of Organizational Sciences, University of Belgrade, SERBIA

Linear Logics of Agency
Daniele Porello
Laboratory for Applied Ontology, Institure for Cognitive Sciences and Technologies, ISTC, CNR, ITALY

A proof-theoretic criterion of synonymy and the distinction between intensional and extensional harmony
Luca Tranchini
Eberhard-Karls-Universität Tübingen, GERMANY

Venue - P723

4.00PM–6.00PM

Contributed Talks 27

Diagrams and small theories
Aida Alibek
University of Illinois at Chicago, UNITED STATES
Bektur Baizhanov
Institute of Mathematics and Mathematical Modelling, UNITED STATES
John Baldwin
University of Illinois at Chicago, UNITED STATES
Aisha Yershigeshova
Institute of Mathematics and Mathematical Modelling, UNITED STATES
Tatyana Zambarnaya
Institute of Mathematics and Mathematical Modelling, UNITED STATES

Zero-one laws for edge weighted graphs
Caroline Terry
University of Illinois at Chicago, UNITED STATES

Integration on the Surreals: A Conjecture of Conway, Kruskal and Norton
Philip Ehrlich
Ohio University, UNITED STATES
Ovidiu Costin
The Ohio State University, UNITED STATES

Surreal numbers, derivations and transseries
Alessandro Berarducci
Dipartimento di Matematica, Universita’ di Pisa, ITALY
Vincenzo Luca Mantova
Scuola Normale Superiore, Pisa, ITALY

Properties of central type for fragments of Jonsson sets
Aibat Yeshkeyev, Karaganda State University, KAZAKHSTAN

Venue - P724

7.30PM–12.00AM

Congress Dinner

The congress dinner is served at the Restaurant Bank, conveniently located a few blocks away from the colloquium venue. The dinner quests a treated to a three course meal in the functionalist-style old bank building with unique wall paintings and ornaments. Restaurant Bank focuses on modern Finnish cuisine prepared from the best seasonal ingredients.

The Congress Dinner requires online preregistration. The price of the dinner is 50 € (incl. three courses and accompanying wines). There might be some extra dinner tickets for sale at the Congress Office (the Porthania lobby) during the first colloquium days.

Venue - Restaurant Bank (Unioninkatu 20)

SATURDAY 8 AUGUST

9.00AM–10.00AM

Plenary Lecture: Sergei Artemov

Constructive knowledge
Sergei Artemov
CUNY, UNITED STATES

Venue - PI

10.00AM–10.30AM

Coffee

Venue - Porthania Lobby

10.30AM–11.30AM

Tutorial 2.3

Dependence and Independence in Logic
Erich Grädel
RWTH Aachen, GERMANY

PI

11.30AM–1.00PM

Lunch

Lunch at the Main Building Unicafe (Fabianinkatu 33, co-located with CLMPS 2015) for participants who have purchased the additional lunch package.

Venue - Main Building Unicafe

1.00AM–2.00PM

Plenary Lecture: Andrei Morozov

Computable model theory over the reals: some results and problems
Andrei Morozov
Novosibirsk, RUSSIAN FEDERATION

Venue - PI

2.05PM–3.35PM

Plenary Lecture: Ilias Farah

Quantum ultrafilters
Ilias Farah
York University, CANADA

+ closing words (30 min)

Venue: PI

TUTORIALS

ON THE SET THEORY OF GENERALIZED LOGICS

Tutorial 1.1: Monday, 3 August • 12.05PM–1.05PM
Tutorial 1.2: Tuesday 4, August • 10.30AM–11.30AM
Tutorial 1.3: Wednesday 5 August • 10.30AM–11.30AM
Venue – PI

▸ MENACHEM MAGIDOR, *On the Set Theory of Generalized Logics*.
Einstein Institute of Mathematics, Hebrew University of Jerusalem, Israel.
E-mail: `mensara@savion.huji.ac.il`.

Many interesting properties of mathematical structures and elements of such structures can not be expressed in first order logic. Generalized logics attempt to provide mechanisms for expressing such properties. Second order logic is a prime example of such logic.

When one attempts to develop the model theory of a logic generalizing first order logic, one runs into the problem that model theoretic properties of the logic like compactness, Löwenheim-Skolem Theorem, the robustness of the set of validities of the logic across different universes of Set Theory etc. depend very much on the set theoretical assumptions about the universe, like cardinal arithmetics, the existence of large cardinals, robustness of set theoretical properties under forcing extensions etc.

In this series of three lectures we shall present some of these connections between Set Theory and the model theory of generalized logics. Typical examples will be the equivalence between different cases of compactness theorems and large cardinals. Because of time constrains we shall not always be able to provide complete proofs, but we hope to get the important ideas across.

DEPENDENCE AND INDEPENDENCE IN LOGIC

Tutorial 2.1: Thursday, 6 August • 11.00AM–12.00PM
Tutorial 2.2: Friday, 7 August • 10.30AM–11.30AM
Tutorial 2.3: Saturday, 8 August • 10.30AM–11.30AM
Venue – PI

▸ ERICH GRÄDEL, *Dependence and Independence in Logic*.
RWTH Aachen.
E-mail: `graedel@logic.rwth-aachen.de`.

Dependence and independence are general scientific concepts that play a fundamental role in many disciplines. Classical proposals for incorporating concepts of dependence or independence into mathematical logic include Henkin quantifiers and independence friendly logics giving for each quantifier explicit information on how variables may or may not depend on each other. Modern dependence logics instead treat dependence and independence as atomic properties, rather than as annotations of quantifiers.

Dependence and independence are concepts that do not manifest themselves in a single assignment, mapping variables to elements of a structure, but only in larger amounts a data, such as a table or relation, or a set of assignments. Accordingly, logics of dependence and independence have a semantics that, unlike Tarski semantics, are based on sets of assignments. Sets of assignments are called teams and the semantics is called team semantics.

In this tutorial we shall introduce a number of variations of logics of dependence, discuss their model-theoretic properties, expressive power, and algorithmic complexity. We shall design model-checking games for logics with team semantics in a general and systematic way, based on a notion of second-order reachability games. One of the most intriguing results on logics of dependence and independence is the tight connection between inclusion logic and the least fixed-point logic LFP. We shall discuss this connection from a game-theoretic point of view, by showing that the evaluation problems for both logics can be represented by a special kind of trap condition in safety games. We then study interpretation arguments for games that provide a model-theoretic construction of translations between these logics.

PLENARY LECTURES

PLENARY LECTURE: JOHAN VAN BENTHEM

Monday, 3 August • 5.00PM–6.30PM
Venue - Great Hall, Main Building

▸ JOHAN VAN BENTHEM, *Computable, uniform, and strong reductions.*
University of Amsterdam, Stanford University, and Tsinghua University.
E-mail: `j.vanbenthem@uva.nl`.

Logic has had two aspects throughout its history. It is a theory of what follows from what when describing the structure of reality – but also, it offers an account of rational intellectual activity as shown in making decisions or engaging in debate. On the first view, logic would even govern a lifeless storm-swept universe; on the second view, the nature of the reasoning agents is crucial as well as their activities. Of course, the two views, one more static, the other more dynamic, are not at odds: agents have come to be successful in harmony with the world they live in.

In this lecture, I explore the agency perspective through the lense of interfaces between logic and games. Games are a microcosm of about every major notion that has been studied separately in philosophical and computational logic, and their uses extend well beyond, into epistemology and the methodology of science. I will first consider current uses of logic to understand games, or more generally, the laws that underlie information- driven intentional behavior of agents that pursue goals, and that do so by interacting strategically. This leads to what may be called a "theory of play" merging ideas from logic and game theory. But then I reverse perspective, and consider uses of games to elucidate basic notions in logic, including dialogical accounts of the very logical constants. In my view, this circle, or helix, is the DNA of the field. But the connection between the two perspectives is not unproblematic or well-understood, and I will also point at some serious issues in understanding the total picture.

In the final part of my lecture, I will look at some more general methodological issues confronting the study of logic and rational agency, illustrated by themes from the games arena that we saw earlier. These issues are not particular to logic, and can also be discerned in other fields represented at this Congress. I intend to discuss the methodological shift from being to change as a major focus of study, as well as two challenges emanating from contacts with other disciplines where agency is crucial. One is the challenge of evolutionary game theory or dynamical systems with successful low-rationality scenarios, and the other is the modern encounter with empirical cognitive science, where the received descriptive/ normative boundary protecting the inner sanctum of traditional logic sometimes seems at breaking point when streams of intellectual traffic clamor for permission to cross.

References:

J. van Benthem, 2011, "Logical Dynamics of Information and Interaction", Cambridge University Press; 2014, "Logic in Games", The MIT Press, 2015, "Fanning the Flames of Reason", ILLC, University of Amsterdam.

PLENARY LECTURE: ARTEM CHERNIKOV

Tuesday, 4 August • 9.00AM–10.00AM
Venue - PI

▸ ARTEM CHERNIKOV, *Applications of model theory in extremal graph combinatorics.*
Équipe de Logique Mathématique, Institut de Mathématiques de Jussieu - Paris Rive Gauche, UFR de Math., case 7012, 75205 Paris Cedex 13, France.
E-mail: `artem.chernikov@imj-prg.fr`.
URL Address: `http://chernikov.me/`.

Szemerédi regularity lemma is a fundamental result in graph combinatorics with numerous applications in additive number theory, computer science and other fields. Roughly speaking, it asserts that every large enough graph can be partitioned into boundedly many sets so that on almost all pairs of those sets the edges are approximately uniformly distributed at random.

It was demonstrated by Gowers that in general the size of the required partition grows as an exponential tower in terms of the allowed error. Recently several improved regularity lemmas giving much better bounds were obtained for restricted families of graphs: algebraic graphs of bounded complexity in large finite fields (Tao [1]), semi-algebraic graphs of bounded complexity (Fox, Gromov, Lafforgue, Naor, Pach [3, 4]), graphs of bounded VC-dimension (Lovász, Szegedy [5]), graphs without arbitrary large half-graphs (Malliaris, Shelah [2]).

It turns out that these results are closely related to the model-theoretic classification theory, Shelah's stability and its generalizations. I will give a survey of the area stressing this point and present some recent joint work with Sergei Starchenko on generalizations of the semialgebraic case.

[1] TAO, TERENCE, *Expanding polynomials over finite fields of large characteristic, and a regularity lemma for definable sets*, ***Preprint***, arXiv:1211.2894 (2012).

[2] MALLIARIS, MARYANTHE AND SHELAH, SAHARON, *Regularity lemmas for stable graphs*, ***Transactions of the American Mathematical Society***, vol. 366 (2014), no. 3, pp. 1551–1585.

[3] FOX, JACOB AND GROMOV, MIKHAIL AND LAFFORGUE, VINCENT AND NAOR, ASSAF AND PACH, JÁNOS, *Overlap properties of geometric expanders*, ***Journal für die reine und angewandte Mathematik (Crelles Journal)***, vol. 2012 (2012), no. 671, pp. 49–83.

[4] FOX, JACOB AND PACH, JANOS AND SUK, ANDREW, *A polynomial regularity lemma for semi-algebraic hypergraphs and its applications in geometry and property testing*, ***Preprint***, arXiv:1502.01730 (2015).

[5] LÁSZLÓ LOVÁSZ AND BALÁZS SZEGEDY, *Regularity partitions and the topology of graphons*, ***An irregular mind***, Springer, 2010, pp. 415–446.

[6] ARTEM CHERNIKOV AND SERGEI STARCHENKO, *A note on the Erdős-Hajnal property for stable graphs*, ***Preprint***, arXiv:1504.08252 (2015).

[7] ARTEM CHERNIKOV AND SERGEI STARCHENKO, *Regularity lemma for distal structures*, ***Preprint*** (2015).

PLENARY LECTURE: DANIELLE MACBETH

Wednesday, 5 August • 9.00AM–10.00AM
Venue - PI

▸ DANIELLE MACBETH, *Logical Form, Mathematical Practice, and Frege's Begriffsschrift.*
Haverford College, USA.
E-mail: dmacbeth@haverford.edu.
In 1879 Frege published a little monograph introducing a logical language of his own devising that he called Begriffsschrift, concept-script. For over a century, we have read this language as a notational variant of our own mathematical logic. In Frege's Logic (Harvard UP, 2005), I argued that this is a mistake, that Frege's notation functions in a very different way from the way our standard notations of logic function. What I did not do in that book is to locate Frege's logic in the context of nineteenth-century mathematical practice; I did not see his logic as a development of that mathematical practice. That, I have since realized, is precisely what it is: Frege's concept-script was designed as a language within which to reason deductively from defined mathematical concepts to theorems in the style that by the end of the nineteenth century had become exemplary of mathematical practice. With Frege's proof of Theorem 133 in Part III of the 1879 logic as my case study, I show how reasoning in Begriffsschrift is at once continuous with and a major advance beyond earlier mathematical practices involving systems of written signs within which to reason, in particular, how it enables proofs in mathematics that are strictly deductive and at the same time ampliative, real extensions of our knowledge. Frege's concept-script, we will see (and as is explained in much greater detail in my Realizing Reason: A Narrative of Truth and Knowing (Oxford UP 2014)), is essentially different from any logical notation in use today and especially well suited to mathematics as it has come to be practiced since the nineteenth century.

PLENARY LECTURE: KOBI PETERZIL

Wednesday, 5 August • 2.30PM–3.30PM
Venue - PI

▸ KOBI PETERZIL, *Topological groups and stabilizers of types.*
University of Haifa, Israel.
E-mail: kobi@math.haifa.ac.il.
We consider topological groups which are definable in some structure M (by that we mean that the group and a basis for its topology are definable in M). The partial type of all definable open neighborhoods of e gives rise to an equivalence relation on the space of complete types, on which the group G acts.

A combination of techniques from model theory and topological dynamics yields, under proper assumptions, detailed analysis of this G-space, and in particular the definability of the stabilizer group of definable types in G. In the o-minimal setting these groups turn out to be solvable, torsion-free with additional information about their dimension.

(Joint work with S. Starchenko)

PLENARY LECTURE: STEVE AWODEY

Thursday, 6 August • 9.00AM–10.30AM
Venue - PI

▸ STEVE AWODEY, *Cubical homotopy type theory and univalence.*
Carnegie Mellon University, USA.
E-mail: steveawodey@icloud.com.
In this work-in-progress talk, I will present the cubical model of homotopy type theory recently developed by Coquand et al., making a few modifications along the way. The basic category of cubes is simplified by exploiting the duality between cartesian cubes and bipointed sets. The presheaf category of cubical sets is then a classifying topos with good logical, combinatorial, and geometric properties. The Kan extension property familiar from algebraic topology is just what is required to model the identity-type rules of Martin-Löf. The univalence axom of Voevodsky is then considered in the cubical setting, which is more constructive than the classical one of simplicial sets.

PLENARY LECTURE: SEBASTIAAN TERWIJN

Thursday, 6 August • 12.05 PM-01.05 PM
Venue - PI

▸ SEBASTIAAN TERWIJN, *Probability Logic.*
Radboud University Nijmegen.
E-mail: terwijn@math.ru.nl.
Probability logic may refer to any kind of combination of logic and probability, of which there are many, ranging from philosophy to computer science. In this talk we will survey various kinds of probability logic, and also discuss some recent work in this area.

In the context of mathematical logic, the literature may be divided roughly into two parts. First, there is what may be called the "probabilities over models" approach, where probabilities are imported by considering probability distributions over classes of models. An example of this are the various probabilistic logics used in model checking. Second, there is the "models with probabilities" approach, where the probabilities are internal to the models under consideration. In this talk we will focus on the second approach, though, as we will discuss, it turns out that the two approaches are not wholly unrelated. We will discuss various logics falling under the "models with probabilities" heading, including logics with probability quantifiers introduced by Keisler, Valiant, Terwijn, and Goldbring and Towsner. Though the motivation for studying these logics is rather different, there are interesting connections, both technical and conceptual.

PLENARY LECTURE: TOSHIYASU ARAI

Friday, 7 August • 9.00AM–10.00AM
Venue - PI

▸ TOSHIYASU ARAI, *Proof theory of set theories.*
Graduate School of Science, Chiba University, Chiba, 263-8522, JAPAN.
E-mail: tosarai@faculty.chiba-u.jp.

Proof theory is a branch of mathematical logic in which (mathematical) proofs are treated as formal objects, while in (axiomatic) set theory we investigate universes of sets and propositions which are supposed to hold in universes of sets. Universes of sets are ought to obey axioms of (formal) set theory.

Here we are concerned with formal proofs in set theory asking questions: Which kind of sets are proved to exist?

In set theory, a reflection principle says that a proposition true in the universe holds already in a smaller set. The reflection principle has been one of sources to formulate large cardinals, e.g., indescribable cardinals due to Hanf-Scott. A hierarchy of indescribable cardinals is known to be obtained by enlarging classes of formulas to be reflected, and/or restricting reflecting points.

On the other side, recursive analogues of small large cardinals such as indescribable cardinals (reflecting ordinals due to Richter-Aczel) have been investigated in proof theory, i.e., ordinal analyses of extensions of Kripke-Platek set theory.

Combining these two, we report recent progress in proof-theoretic investigations of set theory such as bounding on provably existing countable ordinals and proof-theoretic reductions of higher indescribability to iterations of lower indescribabilities.

PLENARY LECTURE: RALF SCHINDLER

Friday, 7 August • 11.35PM–12.35PM
Venue - PI

▸ RALF SCHINDLER, *Martin's Maximum, Woodin's ($\star$), or both?.*
Institut für mathematische Logik und Grundlagenforschung, Fachbereich Mathematik und Informatik, Universität Münster.
E-mail: rds@wwu.de.

Abstract: There are two plausible strong axioms available on the market which both imply that there are $\aleph_2$ reals, Martin's Maximum and Woodin's ($\star$). It is still unknown if these two are compatible with each other. This question leads to the formulation of a unifying strong axiom and also to studying apparently unrelated issues from descriptive inner model theory. This is joint work with Aspero, Claverie, Doebler, and Woodin.

PLENARY LECTURE: SERGEI ARTEMOV

Saturday, 8 August • 9.00-10.00
Venue - PI

▸ SERGEI ARTEMOV, *Constructive knowledge.*
Computer Science, CUNY Graduate Center, 365 Fifth Ave, New York, United States.
E-mail: sartemov@gc.cuny.edu.

The constructive approach considers a proposition true only when there is a conclusive proof of it. This leads to the Brouwer-Heyting-Kolmogorov semantics and a variety of intuitionistic logic systems. Likewise, constructive knowledge is viewed as a result of verification, not necessarily producing an explicit proof of what has been verified. Since conclusive proofs can serve as verifications, constructive truth, under the natural assumptions that the corresponding conclusive proof is available and recognized as such, yields constructive knowledge. Within the framework of intuitionstic logic augmented by the "knowledge modality" **K** this can be formulated as the fundamental co-reflection principle: *constructive truth yields constructive knowledge*

$$p \to \mathbf{K}p.$$

This helps to resolve the knowability paradox by Church and Fitch which appears due to an unwarranted classical reading of constructive epistemic principles [3, 4]. Furthermore, the well-known Russell [1] and Gettier [2] "counterexamples" to the principle

(1) *justified true belief yields knowledge,*

sometimes attributed to Plato, do not survive constructive analysis. Moreover, we argue that the following constructive version of (1) does hold:

> *constructive truth and belief on the basis of the corresponding conclusive justification/proof yields knowledge.*

These and other observations led to formal systems of intuitionistic epistemic logic IEL, developed jointly with Tudor Protopopescu [4].

[1] B. Russell, ***The problems of philosophy***, London: Williams and Norgate; New York: Henry Holt and Company, 1912.

[2] E. Gettier, *Is justified true belief knowledge?* ***Analysis***, vol. 23 (1963), no. 6, pp. 121–123.

[3] S. Artemov and T. Protopopescu, *Discovering knowability: a semantic analysis*, ***Synthese***, vol. 190 (2013), no. 16, pp. 3349–3376.

[4] S. Artemov and T. Protopopescu, ***Intuitionistic epistemic logic***, arXiv preprint arXiv:1406.1582, 2014.

PLENARY LECTURE: ANDREI MOROZOV

Saturday, 8 August • 1.00AM–2.00PM
Venue - PI

▸ ANDREY MOROZOV, *Computable model theory over the reals: some results and problems.*
Sobolev institute of mathematics and Novosibirsk State University, Koptyug Ave. 4, 630090, Novosibirsk, Russia.
E-mail: morozov@math.nsc.ru.

Σ–Definability in the hereditarily finite superstructure HF(R) over the reals can be considered as a generalized version of computability. The talk is devoted to Σ–definable structures. Σ–Definable structures can be viewed as structures that could serve as abstract data types for a hypothetical programming language having the ordered field of the real numbers (not their approximations) as one of its basic data types.

The talk is a survey of recent results on Σ–definable structures. Mainly we discuss the problem of existence of Σ–presentations, on the number of such presentations, and the existence of parameterizations for classes of Σ–presentations.

PLENARY LECTURE: ILIAS FARAH

Saturday, 8 August • 2.05PM–3.35PM
Venue: PI

▸ ILIJAS FARAH, *Quantum ultrafilters.*
Department of Mathematics and Statistics
York University
4700 Keele Street
North York, Ontario
Canada, M3J 1P3; and Matematicki Institut, Kneza Mihaila 34, Belgrade, Serbia.
E-mail: ifarah@yorku.ca.
URL Address: http://www.math.yorku.ca/∼ifarah.

Several old and well-known problems on representations of C*-algebras (some solved, some partially solved, some open) can be reformulated in terms of non-commutative analogues of maximal filters, or 'quantum ultrafilters.' The rich structure of C*-algebras is reflected in the intricate formation of the their quantum ultrafilters. I will talk about the similarities and differences of with 'standard? ultrafilters and why logicians may want to learn more.

SPECIAL SESSIONS

SPECIAL SESSION ON SET THEORY

SPECIAL SESSION ON SET THEORY 1

Monday, 3 August • 10.30AM–12.00AM
Venue – PII

▸ LAURA FONTANELLA, *Reflection and Anti-reflection at the Successor of a Singular Cardinal.*
Department of Mathematics, Hebrew University, Edmund J. Safra Campus Givat Ram Jerusalem, Israel.
E-mail: laura.fontanella@mail.huji.ac.il.

This is a joint work with Yair Hayut [1]. One of the most fruitful research areas in set theory is the study of the so-called "reflection principles". These are statements establishing, roughly, that for a given structure (a stationary set, a tree etc.) and a given property, one can find a substructure of smaller cardinality satisfying the same property. Reflection principles are typical properties of large cardinals but can consistently hold even at small cardinals. Square principles are on the contrary anti-reflection principles as they imply the failure of several reflection principles and are false in the presence of certain large cardinals. We present a technique for building models where a reflection principle and a square principle hold simultaneously at the successor of a singular cardinal. We discuss two particular principles: the so-called Delta reflection which is due to Magidor and Shelah [2], and a version of the square due to Todorcevic [3]. More precisely, we show that, starting from a suitable large cardinal assumption, one can force a model where both the Delta reflection and Todorcevic's square hold at $\aleph_{\omega^2+1}$.

[1] L. Fontanella and Y. Hayut, *Square and Delta reflection*, submitted.
[2] M. Magidor and S. Shelah, *When does almost free implies free*, ***Journal of the American Mathematical Society***, vol. 7 (1994), no. 4, pp. 769–830.
[3] S. Todorcevic, *Partitioning paris of countable ordinals*, ***Acta Mathematica***, vol. 159 (1987), no. 3-4, pp. 261–294.

▸ PETER HOLY, *Condensation does not imply Square.*
Department of Mathematics, University of Bonn, Endenicher Alle 60, 53115 Bonn, Germany.
E-mail: maxph@math.uni-bonn.de.
URL Address: http://www.math.uni-bonn.de/people/pholy/.

All known arguments to verify square principles in L rely on some sort of fine structural machinery. It is generally believed that this is in fact necessary. We support this belief by showing that (a certain form of) Condensation does not imply square to hold. The large cardinal assumption for this proof will be a 2-Mahlo cardinal. This is joint work with Philip Welch and Liuzhen Wu.

SPECIAL SESSION ON SET THEORY 2

Tuesday, 4 August • 2.00PM–3.30PM
Venue - PII

▸ ALEKSANDRA KWIATKOWSKA AND DANA BARTOŠOVÁ, *Dynamics of the homeomorphism group of the Lelek fan.*
Department of Mathematics, University of Bonn, Germany.
E-mail: `akwiatkowska314@gmail.com`.
Institute de Matematica e Estatística, Universidade de São Paulo, Brazil.
E-mail: `dana@ime.usp.br`.

The Lelek fan L is a compact connected metric space with many symmetries and very rich homeomorphism group. It can be constructed from a projective Fraïssé limit.

I will discuss properties and I will talk about the dynamics of $H(L)$, the homeomorphism group of the Lelek fan. In particular, using the Graham-Rothschild Ramsey theorem about partitions, the Kechris-Pestov-Todorcevic correspondence, as well as some new ideas, I will describe the universal minimal flow of $H(L)$.

▸ PHILIPP SCHLICHT, *Forcing and generic absoluteness without choice.*
Universität Münster.
E-mail: `schlicht@math.uni-bonn.de`.

It is much harder to force over models of set theory without choice, since some conditions for cardinal preservation fail, for instance sigma-closed forcing may collapse cardinals. In the positive direction, we show that finite support iterations of definably sigma-linked forcings preserve cardinals and that random algebras are complete Boolean algebras and preserve cardinals. Some other well-known properties of forcings are related to choice principles, for instance adding a Cohen subset of ω_1 preserves cardinals if and only if dependent choice for reals holds. We consider the following version of generic absoluteness for a class C of forcings: the truth of all sentences is absolute between the ground model and all extensions by forcings in C. A result of Woodin shows that generic absoluteness for finite support products of Cohen forcings implies that all uncountable cardinals are singular. In Gitik's model where all uncountable cardinals are singular, this form of generic absoluteness fails. This is joint work with Daisuke Ikegami.

SPECIAL SESSION ON PROOF THEORY

SPECIAL SESSION ON PROOF THEORY 1

Monday, 3 August • 10.30AM–12.00AM
Venue - PIII

▸ DAVID FERNÁNDEZ-DUQUE, *Transfinite reflection principles and subsystems of second-order arithmetic.*
Instituto Tecnológico Autónomo de México.
E-mail: `david.fernandez@itam.mx`.

If we use $\Box_T\phi$ to denote a natural formalization of *The formula ϕ is provable in T,* then *uniform reflection over T* is the schema

$$\mathtt{RFN}(T) = \forall x\big(\Box_T\phi(\bar{x}) \to \phi(x)\big).$$

It is then natural to consider the extension $T + \mathtt{RFN}(T)$ of T, which by Gödel's second incompleteness theorem is a proper extension whenever T is consistent. Moreover, such an extension sometimes gives rise to familiar theories; for example, if we let EA (Elementary Arithmetic) be the subsystem of Peano Arithmetic (PA) with exponentiation where induction may only be applied to Δ^0_0 formulas, then PA $\equiv$ EA $+ \mathtt{RFN}$(EA) [4].

In this presentation we will discuss recent results, obtained in joint work with Andrés Cordón-Franco, Félix Lara-Martín and Joost J. Joosten [2] that give rise to analogouns representations of subsystems of second-order arithmetic. They are based on a formalization of the ω-rule in the language of second-order arithmetic [3], where we read $[\Lambda|X]_T\phi$ as *The formula φ is provable in T using nested ω-rules along Λ with an oracle for X,* where Λ is a well-order on the naturals and $X \subseteq \mathbb{N}$ is an arbitrary subset. Define $\langle\Lambda|X\rangle_T\phi$ as a shorthand for $\neg[\Lambda|X]_T\neg\phi$, so that in particular $\langle\Lambda|X\rangle_T\top$ asserts that T does not reach an inconsistency even after iterating ω-rules along Λ.

Let $\mathtt{wo}(\Lambda)$ be a formula stating that Λ is a well-order and consider the following principles:

$$\mathtt{PredCons}(T) \equiv \forall\Lambda\forall X\big(\mathtt{wo}(\Lambda) \to \langle\Lambda|X\rangle_T\top\big);$$
$$\mathtt{PredRFN}_T(\Gamma) \equiv \forall\Lambda\forall X\big(\mathtt{wo}(\Lambda) \to ([\Lambda|X]_T\phi \to \phi)\big),$$

where Γ is a set of formulas and $\phi \in \Gamma$. We then have the following result:

THEOREM 1. ATR_0, $\mathtt{PredCons}(\mathrm{RCA}_0)$ *and* $\mathtt{PredRFN}_{\mathrm{RCA}_0}(\Pi^1_2)$ *are all equivalent over* RCA_0.

Moreover, by restricting Λ to small well-orders we can represent systems between ACA_0 and ATR_0 in a similar fashion, whereas by allowing unbounded applications of the ω-rule we may obtain a theory equivalent to $(\mathbf{\Pi}^1_1\text{-CA})_0$.

In this way, transfinite reflection principles give rise to a spectrum of theories of second-order arithmetic encompassing many of the important systems of reverse mathematics. We will also discuss possible applications towards a Π^0_1 ordinal analysis of such theories, in the spirit of Beklemishev's analysis of PA [1].

[1] L. D. Beklemishev, *Provability algebras and proof-theoretic ordinals, I*, ***Annals of Pure and Applied Logic***, vol. 128 (2004), pp. 103–124.

[2] A. Cordón-Franco, D. Fernández-Duque, J. J. Joosten, and F. Lara-Martín, *Predicativity through transfinite reflection*, ***ArXiv***, (2014).

[3] D. Fernández-Duque and J. J. Joosten *The omega-rule interpretation of transfinite provability logic (submitted)*, ***ArXiv***, 1205.2036 [math.LO] (2013).

[4] G. Kreisel and A. Lévy *Reflection principles and their use for establishing the complexity of axiomatic systems*, ***Zeitschrift für mathematische Logik und Grundlagen der Mathematik***, vol. 14 (1968), pp. 97–142.

▸ GILDA FERREIRA, *Atomic polymorphism: an overview.*
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Girard-Reynolds polymorphic lambda calculus [5, 7], also known as system $\mathbf{F}$, is an elegant system introduced in the early seventies with only two generators of types (formulas): implication and second-order universal quantification. Its impredicative feature - second-order quantifications may instantiate arbitrary types - explains the remarkable expressive power of $\mathbf{F}$ but also the difficulty of reasoning about the system. In the present talk we are interested in a predicative variant of system $\mathbf{F}$, known as the *atomic polymorphic calculus* [1], or system $\mathbf{F_{at}}$. $\mathbf{F_{at}}$ has the exact same types (formulas) as $\mathbf{F}$, but a severe restriction on the range of the type variables: only atomic universal instantiations are allowed. We present $\mathbf{F_{at}}$ and give an overview of some proof-theoretic properties of the system such as the strong normalization property [3], the subformula property [1], the sound and faithful embedding of the full intuitionistic propositional calculus into $\mathbf{F_{at}}$ [2, 4], the disjunction property [1], etc. Moreover, we claim that $\mathbf{F_{at}}$ is the proper setting for the intuitionistic propositional calculus, avoiding this way the connectives $\perp$ and $\vee$, whose natural deduction elimination rules have been subject to harsh criticism (see [6] pages 74, 80), and avoiding the *ad hoc* commuting conversion needed in the usual presentation of the latter calculus.

[1] F. Ferreira, *Comments on predicative logic*, ***Journal of Philosophical Logic***, vol. 35 (2006), pp. 1–8.

[2] F. Ferreira and G. Ferreira, *Commuting conversions vs. the standard conversions of the "good" connectives*, ***Studia Logica***, vol. 92 (2009), pp. 63–84.

[3] ——— *Atomic polymorphism*, ***The Journal of Symbolic Logic***, vol. 78 (2013), no. 1, pp. 260–274.

[4] ——— *The faithfulness of* $\mathbf{F_{at}}$*: a proof-theoretic proof*, ***Studia Logica***. To appear.

[5] J.-Y. Girard, *Une extension de l'interprétation de Gödel à l'analyse, et son application à l'élimination des coupures dans l'analyse et la théorie des types*, ***Proceedings of the second Scandinavian Logic Symposium*** (J. E. Fenstad, editor), North Holland, Amsterdam, 1971, pp. 63–92.

[6] J.-Y. Girard, Y. Lafont, P. Taylor, ***Proofs and Types***, Cambridge University Press, 1989.

[7] J. C. Reynolds, *Towards a theory of type structure*, ***Lecture Notes in Computer Science*** (Colloque sur la programmation), (B. Robinet, editor), vol. 19, Springer, 1974, pp. 408–425.

SPECIAL SESSIONS

SPECIAL SESSION ON PROOF THEORY 2

Tuesday, 4 August • 2.00PM–3.30PM
Venue - PIII

▸ ROMAN KUZNETS, *Proof-theoretic Approach to Craig Interpolation.*
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Craig Interpolation Property (CIP) is one of the fundamental properties of logical theories, with applications to verification, synthesis, description logics, automated reasoning, etc. Proof theory provides a way of establishing the CIP for a logic by constructing interpolants out of derivations in an analytic proof calculus for the logic. One of the limitations of this proof-theoretic method lies in the restricted scope of analytic sequent calculi. With the advent of automated methods for manufacturing cut-free hypersequent calculi, as well as the development of even more general sequent-like formalisms (nested sequents/tree-hypersequents and labelled sequents), recent years have witnessed an explosion of interest in extensions of sequent calculi. With sequent-type systems boldly going where no sequent calculus has gone before, it is time to stretch the limits of the proof-theoretic method accordingly, adapting it to the strange new formalisms.

▸ ELENA NOGINA, *Provability. Explict proofs. Reflection.*
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Gödel considered two approaches to modeling provability. One captured the formal provability and resulted in Gödel-Löb logic GL and Solovay's Completeness Theorem [2]. The other was based on the modal logic S4 and led to the Logic of Proofs LP [1].

The joint logic GLA (stands for Gödel-Löb-Artëmov) of formal provability and explicit proofs, in the union of languages of GL and LP, was introduced in [3]. GLA is supplied with a Kripke-style semantics and a corresponding completeness theorem [4]. Soundness and completeness of GLA with respect to the arithmetical provability semantics is established ([3, 4], cf. also [6]). Within GLA framework, we study [5] reflection principles of Peano Arithmetic PA based on both proof and provability predicates. Any such refection principle is equivalent either to $\Box P \to P$ ($\Box P$ stands for "P is provable") or, for some $k > 0$, to $\Box^k u{:}P \to P$ ($u{:}P$ states "u is a proof of P"). Reflection principles constitute a non-collapsing hierarchy with respect to their deductive strength

$$[u{:}P \to P] \prec [\Box u{:}P \to P] \prec [\Box\Box u{:}P \to P] \prec \ldots \prec [\Box P \to P].$$

[1] S. Artemov, *Explicit provability and constructive semantics*, ***Bulletin of Symbolic Logic***, vol. 7 (2001), no. 1, pp. 1–36.

[2] G. Boolos, ***The logic of provability***, Cambridge University Press, 1993.

[3] E. Nogina, *On logic of proofs and provability*, ***Bulletin of Symbolic Logic***, vol. 12 (2006), no. 2, pp. 356.

[4] E. Nogina, ***On logic of formal provability and explicit proofs***, arXiv preprint arXiv:1405.2559, 2014.

[5] E. Nogina, ***On a hierarchy of refection principles in Peano Arithmetic***, arXiv preprint arXiv:1405.2558, 2014.

[6] T. Sidon, *Provability logic with operations on proofs*, ***Logical Foundations of Computer Science*** Springer, Berlin Heidelberg, 1997, pp. 342–353.

SPECIAL SESSION ON LOGIC AND QUANTUM FOUNDATIONS

SPECIAL SESSION ON LOGIC AND QUANTUM FOUNDATIONS 1

Monday, 3 August • 10.30AM–12.00AM
Venue - PIV

► TAPANI HYTTINEN, GIANLUCA PAOLINI AND JOUKO VÄÄNÄNEN, *Quantum team logic and Bell's Inequalities.*
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A logical approach to Bell's Inequalities of quantum mechanics has been introduced by Abramsky and Hardy [1]. We point out that the logical Bell's Inequalities of [1] are provable in the probability logic of Fagin, Halpern and Megiddo [2]. Since it is now considered empirically established that quantum mechanics violates Bell's Inequalities, we introduce a modified probability logic, that we call quantum team logic, in which Bell's Inequalities are not provable, and prove a Completeness Theorem for this logic. For this end we generalise the team semantics of dependence logic [3] first to probabilistic team semantics, and then to what we call quantum team semantics.

[1] Samson Abramsky and Lucien Hardy, *Logical Bell Inequalities*, ***Physical Review A***, vol. 85 (2012), no. 062114, pp. 1–11.

[2] Ronald Fagin, Joseph Y. Halpern, and Nimrod Megiddo, *A Logic for Reasoning about Probabilities*, ***Information and Computation***, vol. 87 (1990), pp. 78–128.

[3] Jouko Väänänen, ***Dependence Logic***, London Mathematical Society Student Texts, Cambridge University Press, 2007.

► ROSS DUNCAN, *Strong Complementarity and Non-Locality.*
University of Strathclyde, UK.
E-mail: ross.duncan@strath.ac.uk.

Loosely speaking, a pair of quantum observables is called "complementary" when knowledge of one implies ignorance of the other. Complementarity is responsible to much of the "weirdness" in quantum theory. The classic example is position and momentum, however finite dimensional examples such as the Z and X spins are used throughout quantum information processing.

Thanks to a theorem of Coecke, Pavlovic and Vicary, quantum observables can be identified with certain Frobenius algebras; from this perspective complementary observables are those whose algebras satisfy some additional equations. For *strongly* complementary observables these equations have a succinct form: the Frobenius algebras jointly form a Hopf algebra. This purely algebraic characterisation belies their power: strongly complementary observables can be used for many purposes in quantum information processing, and as I will show, strong complementarity is at the heart of quantum non-locality.

SPECIAL SESSION ON LOGIC AND QUANTUM FOUNDATIONS 2

Tuesday, 4 August • 2.00PM–3.30PM
Venue - PIV

► ADAM BRANDENBURGER, *Entropy and Simulation of No-Signaling Models.*
New York University, USA.
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Any no-signaling model can be classically simulated using the notion of 'signed' events (Abramsky, S., and A. Brandenburger, "An Operational Interpretation of Negative Probabilities and No-Signalling Models," 2014). In this talk, I will compare the entropy, suitably defined, of the simulation model with that of the underlying physical model. I will suggest an interpretation of the difference in the entropies.

► SONJA SMETS, *Reasoning about Classical and Quantum Interaction.*
Institute for Logic, Language and Computation, University of Amsterdam, The Netherlands.
E-mail: sonsmets@gmail.com.

In this presentation I focus on a unified logical setting which brings together the work on Dynamic Quantum Logic (DQL) [1,2] and Dynamic Epistemic Logic (DEL) [3,4] in order to reason about both classical and quantum information flow. DQL is used to model the non-classical behavior of quantum systems from an operational perspective, while Dynamic Epistemic Logic is used to model the epistemic states as well as the communication, observations and other informational actions of classical agents. Bringing DQL and DEL together allows us to focus on different applications in which both classical agency and quantum resources play a role. In this context, we pay specific attention to the multi-agent quantum protocols (studied in quantum information theory) in which complex situations are presented which use different types of informational dynamics (classical and quantum). The success of such quantum protocols relies not only on the properties of quantum systems but often also on assumptions which involve classical communication and the agents' epistemic states. Hence, a pure quantum setting alone cannot fully capture, in any explicit way, all those features of both the classical and quantum information flow involved in such multi-agent quantum protocols. To fully specify these complex classical-quantum scenarios, we use the above mentioned logical framework which unites the probabilistic extensions of DQL and DEL. Besides the standard quantum properties such as non-locality and entanglement as well as the epistemic properties of classical agents, other specific features about the classical-quantum interaction refer to the epistemic effects and the ontic effects (see [5]) that result from performing observations or measurements on a quantum system, as well as to the agent's local "control" (i.e. the fact that classical agents may have only access to a part of a quantum system). I will illustrate how to model these specific features in our logical setting by using specific quantum information protocols as examples. The results in this presentation are based on joint work with A. Baltag at the University of Amsterdam.

[1] A. Baltag and S. Smets "LQP: The Dynamic Logic of Quantum Information", Mathematical Structures in Computer Science, 16(3):491-525, 2006.

[2] A. Baltag and S. Smets, "A Dynamic-Logical Perspective on Quantum Behavior", Studia Logica, 89:185-209, 2008.

[3] A. Baltag and L. S. Moss, S. Solecki. "The logic of public announcements, common knowledge, and private suspicions". In I. Gilboa, editor, Proceedings of TARK 98, pp. 43-56, 1998.

[4] A. Baltag and L. Moss, "Logics for Epistemic Programs", Synthese, 139:165-224, 2004.

[5] A. Baltag and S. Smets, "Logics of Informational Interactions", Journal of Philosophical Logic, April 2015, Online First.

SPECIAL SESSION ON MODEL THEORY

SPECIAL SESSION ON MODEL THEORY 1

Wednesday, 5 August • 11.35AM – 1.05PM
Venue - PII

► GARETH BOXALL AND CHARLOTTE KESTNER, *Non-forking formulas in distal NIP theories.*
Department of Mathematical Sciences, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa.
E-mail: gboxall@sun.ac.za.
JH Institute, University of Central Lancashire, Preston, PR12HE, UK.
E-mail: ckestner@uclan.ac.uk.

The following question was asked by Chernikov and Simon in [1]. Let M be a model of a complete NIP theory. Let q be a complete type over M realised by b and let $\varphi(x,b)$ be non-forking over M. Is there a formula $\psi \in q$ such that $\{\varphi(x,c) : c \models \psi\}$ is consistent?

Positive answers have been given by Simon [2] and Simon and Starchenko [3] for certain dp-minimal theories. We give now a positive answer in the case where the theory is distal.

[1] Artem Chernikov and Pierre Simon, *Externally definable sets and dependent pairs II*, ***Transactions of the American Mathematical Society***, vol. 367 (2015), no. 7, pp. 5217–5235.

[2] Pierre Simon, *DP-minimality: invariant types and dp-rank*, ***Journal of Symbolic Logic***, vol. 79 (2014), no. 4, pp. 1025–1045.

[3] Pierre Simon and Sergei Starchenko, *On forking and definability of types in some dp-minimal theories*, ***Journal of Symbolic Logic***, vol. 79 (2014), no. 4, pp. 1020–1024.

► VERA KOPONEN, *Simple homogeneous structures.*
Department of Mathematics, Uppsala university.
E-mail: vera.koponen@math.uu.se.

I call a countable structure M homogeneous if it has a finite relational vocabulary and every isomorphism between finite substructures of M can be extended to an automorphism of M. An equivalent condition (assuming a finite relational language) is that M has elimination of quantifiers. Another equivalent condition is that M is the Fraisse limit of an "amalgamation class" of finite structures. The class of infinite stable homogeneous structures has been classified by Lachlan and others, but not much is known about the more general class of (infinite) simple homogeneous structures. I will talk about some results concerning binary simple homogeneous structures, and mention a number of problems. All known (to me) examples are "well behaved" from a simplicity theoretic perspective; they have finite SU-rank, are 1-based and have trivial dependence/forking. One question is if all simple homogeneous structures are as well behaved in this sense.

The results about Shelah's "CP(, 2)-rank" used to study stable homogeneous structures do not carry over to simple homogeneous structures. Moreover, sets of SU-rank 1 (possibly containing imaginaries) can have a more complex structure when the ambient structure is simple and homogeneous than in the stable case. But if the role of "CP(, 2)-rank" is taken over by SU-rank and the role of indiscernible sets is taken over by random structures, then we get some results for binary simple homogeneous structures which are analogous to results about stable homogeneous structures. For example, every binary simple homogeneous structure is supersimple with finite SU-rank. The results that I will mention about sets of SU-rank 1 and binary primitive structures use the additional assumption that the structure is 1-based. Thus a relevant question is whether there exists any (binary) simple homogeneous structure which is not 1-based. For binary structures one can reduce the problem to this: Can a binary simple homogenous structure have a set of imaginaries of SU-rank 1 and nontrivial algebraic closure on this set? And what about nonbinary simple homogeneous structures? The case of the "generic tetrahedron-free 3-hypergraph", which has SU-rank 1, shows that a new level of complexity is possible for nonbinary simple homogeneous structures.

Relevant articles for this topic can be found on:
http://www2.math.uu.se/˜vera/research/index.html

SPECIAL SESSION ON MODEL THEORY 2

Friday, 7 August • 2.00PM–3.30PM
Venue - PII

► NATHANAËL MARIAULE, *The field of p-adic numbers with a predicate for the powers of a natural number.*
Dipartimento di matematica e fisica, Seconda Universit degli Studi di Napoli, viale Lincoln, 5 - 81100 Caserta, Italy.
E-mail: nathanaeljean.mariaule@unina2.it.

In [1], L. van den Dries axiomatizes the theory of the real field with a predicate for the powers of two (or any integer n). In this talk, I will present a p-adic version of this result. We will see that the techniques et axiomatization depend on the choice of the integer: If the p-adic valuation of n is positive then the multiplicative group generated by n is discrete and this case is similar to the the real case of van den Dries. If the p-adic valuation is zero then the group is dense in a (definable) set of the field of p-adics. For this case, notions such as p-valued $\mathbb{Z}$-groups and Mann property are used.

[1] L. van den Dries, *The field of reals with a predicate for the powers of two*, ***manuscripta mathematica***, vol. 54 (1985), Issue 1-2, pp. 87–195.

► SILVAIN RIDEAU, *Imaginaries and definable types in valued differential fields.*
DMA, École normale supérieure, 45 rue d'Ulm, 75005 Paris, France.
E-mail: silvain.rideau@ens.fr.
URL Address: http://www.eleves.ens.fr/home/srideau/.

In [1], Scanlon showed that valued fields (K,v) equipped with a derivation ∂ such that for all x in K, $v(\partial(x))$ is greater or equal to $v(x)$ admit a model completion that we will call $\mathrm{VDF}_{\mathcal{EC}}$. Some years later, Haskell, Hrushovksi and Macpherson gave a description of the imaginaries (i.e. the definable quotients) in algebraically closed valued fields in term of the so-called "geometric imaginaries". Since then the question whether all the imaginaries in $\mathrm{VDF}_{\mathcal{EC}}$ could also be described in terms of the geometric imaginaries remained open.

In this talk I will give a positive answer to this question by relating it to the density of definable types and by showing how the independence property (or rather its absence) can play a role in controlling the canonical basis of definable types.

[1] T. Scanlon, *A model complete theory of valued D-fields*, ***Journal of Symbolic Logic***, vol. 65 (2000), no. 4, pp. 1758–1784.

SPECIAL SESSION ON COMPUTABILITY THEORY

SPECIAL SESSION ON COMPUTABILITY THEORY 1

Wednesday, 5 August • 11.35AM–1.05PM

Venue - PIII

▸ DAMIR DZHAFAROV, *Computable, uniform, and strong reductions.*
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In reverse mathematics, one establishes connections between mathematical principles by proving implications over the base theory RCA_0. In practice, such implications are often due to the presence of considerably stronger computability-theoretic reducibilities holding between the principles, which are then merely formalized in second-order arithmetic. For instance, a typical implication $P \to Q$ of Π^1_2 principles is a formalized uniform reduction, meaning that there are functionals Φ and Ψ such that, if A is any instance of P, then $\Phi(A)$ is an instance of Q, and if S is any solution to $\Phi(A)$, then $\Psi(A \oplus S)$ is a solution to A. The systematic study of this and related reducibilities in the specific context of Π^1_2 principles has recently emerged as a fruitful enterprise alongside traditional reverse mathematics. On the one hand, it offers a much finer way of calibrating the relative strength of mathematical propositions, and on the other, it sheds light on several open questions from the traditional analysis. This talk will present a summary of results and problems in this direction. In particular, I will discuss the longstanding open question of whether the stable form of Ramsey's theorem for pairs (SRT^2_2) implies the cohesive principle (COH) in standard models of RCA_0, and the growing number of recent results towards a negative answer.

▸ RICHARD SHORE, *The Strength of Turing Determinacy within Second Order Arithmetic.*
Cornell University.
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Turing determinacy states that every two person game building binary sequences for which the winning set is closed under Turing equivalence has a winning strategy for one of the players. A classical result of Martin is that this is equivalent to the winning set or its complement containing all the degrees above some single degree (that of a strategy). It is known that for complicated wining sets this principle is very strong and even of the same strength as that of full determinacy. We investigate the reverse mathematical strength of low levels of Turing determinacy up to that for Σ^0_5 winning sets which is the first level of the arithmetic hierarchy which is not provable in second order arithmetic. Our analyses employ results and techniques from Recursion Theory, Proof Theory, Set Theory, Admissibility theory and L as well as Reverse Mathematics. This is joint work with Antonio Montalbán.

SPECIAL SESSION ON COMPUTABILITY THEORY 2

Friday, 7 August • 2.00PM–3.30PM
Venue - PIII

▸ EKATERINA FOKINA, *Computability-theoretic categoricity at levels 1 and 2.*
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A computable structure $\mathcal{A}$ is called Δ^0_n-categorical if for every computable isomorphic $\mathcal{B}$ there is a Δ^0_n isomorphism from $\mathcal{A}$ onto $\mathcal{B}$. More generally, $\mathcal{A}$ is relatively Δ^0_n-categorical if for every isomorphic $\mathcal{B}$ there is an isomorphism that is Δ^0_n relative to the atomic diagram of $\mathcal{B}$. Relative Δ^0_n-categoricity implies Δ^0_n-categoricity. The converse is in general not true. However, for many natural classes, such as trees of finite height, abelian p-groups, and homogenous completely decomposable abelian groups, the notions of computable categoricity and relative computable categoricity coincide. We investigate Δ^0_2-categoricity for such classes. We also study effective categoricity of Fraïssé limits. Furthermore, we apply the results to compute degrees of categoricity for some Boolean algebras and abelian p-groups. This is joint work with Valentina Harizanov and Daniel Turetsky.

▸ BERNARD ANDERSON, BARBARA CSIMA, AND KAREN LANGE, *Bounded low and high sets.*
Department of Mathematics and Physical Sciences, Gordon State College, 419 College Drive, Barnesville, GA 30204 USA.
Department of Pure Mathematics, University of Waterloo, Waterloo, ON N2L 3G1 Canada.
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Anderson and Csima [1] defined a jump operator, the *bounded jump*, with respect to bounded Turing (or weak truth table) reducibility. They previously showed that the bounded jump is closely related to the Ershov hierarchy and that it satisfies an analogue of Shoenfield jump inversion. We now explore bounded low and high sets. We also consider whether the analogue of the Jump Theorem holds for the bounded jump; do we have $A \leq_{bT} B$ if and only if $A^b \leq_1 B^b$? We show the forward direction holds but not the reverse.

[1] B. A. Anderson and B.F. Csima, *A bounded jump for the bounded Turing degrees*, ***Notre Dame Journal of Formal Logic***, vol. 55 (2014), no. 2, pp. 245–264.

SPECIAL SESSION ON PHILOSOPHY OF MATHEMATICS AND LOGIC

SPECIAL SESSION ON PHILOSOPHY OF MATHEMATICS AND LOGIC 1

Wednesday, 5 August • 11.35AM–1.05PM
Venue - PIV

▸ ANDREW ARANA, *Mathematical depth and Szemerédi's theorem.*
University of Illinois at Urbana-Champaign.
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Many mathematicians have cited depth as an important value in their research. However, there is at present no analysis of mathematical depth that is generally admitted. In this talk I will try to make some progress on this question. I will begin with a discussion of Szemerédi's theorem, that every sufficiently "dense" subset of N contains an arbitrarily long arithmetic progression. This theorem has been judged deep by many mathematicians. Using this theorem as a case study, I will continue by presenting and discussing several different analyses of mathematical depth. In particular I will attend to the objectivity of depth judgments under each analysis.

▸ DENIS BONNAY, *Logic and Invariance: take a step back, look at the bigger picture and devour the whale (one bit a time).*
Paris Ouest University – IHPST.
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What is special with logical notions? Tarski's approach to the question, in terms of invariance under isomorphism, has recently been revisited and various alternative invariance criteria, or ways of applying invariance, have been put on the table. On the other hand, the whole approach has been criticized on account that it does not do justice to the open-ended of new logical systems. My aim in the talk will be to clarify what is the role that invariance criteria are meant to play, and how we should assess their success or failure. In particular, I will press the following three questions:

- How good are the conceptual motivations in favor of invariance criteria?
- How good are invariance criteria in explaining how logical notions are generated (e.g. by means of abstraction principles)?
- How do invariance criteria and inferential characterization relate? Are they rival approaches or do they supplement each other?

SPECIAL SESSION ON PHILOSOPHY OF MATHEMATICS AND LOGIC 2

Friday, 7 August • 2.00PM–3.30PM
Venue - PIV

▸ JANET FOLINA, *Towards an understanding of mathematical understanding.*
Macalester College.
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It is said that a picture is worth a thousand words, and that seeing is believing. But what is the role and status of pictorial information in mathematics? How does understanding via images relate to verbal/symbolic understanding in mathematics?

The role of images in mathematics is just one of many issues in an account of mathematical understanding. Others include: mathematical beauty, depth, generality, explanation, and mathematical intuition. In this programmatic talk I will argue that the structuralist viewpoint shows promise for providing a unified account of these central questions regarding mathematical understanding.

From early 18th century defenses of calculus to Benacerraf-type arguments (and their successors), structuralism is typically supported by considerations regarding the subject matter and ontology of mathematics. These include the increasing abstraction of mathematics as well as the simple implausibility of the view that mathematics is about particular mathematical objects as individuals. This project aims to show that structuralism not only offers a plausible ontology of mathematics; it also provides a satisfying approach to at least one question regarding its epistemology - that of mathematical understanding.

▸ RICHARD PETTIGREW, *Instrumental nominalism about set-theoretic structuralism.*
University of Bristol, United Kingdom of Great Britain and Northern Ireland.
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Set-theoretic structuralism is the thesis that the subject matter of mathematics is comprised of set-theoretic structures. For instance, number theory, on this view, concerns what is true in all simply infinite systems, while real analysis studies what is true in all complete ordered fields. Instrumental nominalism about a particular subject matter, on the other hand, is the claim that a sentence that seems, on the face of it, to concern that subject matter is in fact agnostic about its existence and instead says that the world is *as if* the subject matter existed and had the properties ascribed to it by the sentence. Thus, instrumental nominalism about natural numbers says that the sentence 'There are nine planets' is in fact agnostic about the existence of numbers, but says that the rest of the world is exactly as it would be if there were numbers and the number of the planets were 9. In this paper, I wish to argue that the correct semantics for mathematics is obtained by combining these two positions into instrumental nominalism about set-theoretic structuralism (INSTS). I will argue that this gives a unified and plausible interpretation of mathematical language that allows a natural account of the epistemology of mathematics, its applicability and its methodology.

CONTRIBUTED TALKS

CONTRIBUTED TALKS 1

Tuesday, 4 August • 4.00PM–6.00PM
Venue - PI

► JORGE CELY, *Applications of motivic integration to the fundamental lemma.*
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The Fundamental Lemma was formulated by Langlands in the context of endoscopy theory for automorphic representations, it corresponded to a series of conjectural identities between orbital integrals of a reductive groups over a local field, and stable orbital integrals on its endoscopic groups.

The theory for real groups was established, almost entirely, by Shelstad. The situation for groups over other local fields took more time and the effort of many people (Saito, Shintani, Langlands, Kottwitz, Labesse, Kazhdan, Waldspurger, Hales, Rogawski, Laumon, Schroder, Weissauer), particular cases and important reductions (for the general proof) were proved before Ngô had completed a general proof, in 2010 he was awarded the Fields Medal for this proof.

In [2], Cluckers, Hales and Loeser explain how the general transfer principle of Cluckers and Loeser may be used in the study of the Fundamental Lemma, the link is given by motivic integration. Cluckers and Loeser [1] developed a theory of motivic integration based on the model theory of valued fields (with the Denef-Pas language), in this framework they obtained transfer principles in the spirit of Ax-Kochen-Eršov principle, more specifically these results transfer theorems about identities of p-adic integrals from one collection of fields to others. The general idea in [2] is to show that the identities of orbital integrals involved in the Fundamental Lemma have a motivic nature (in a sense, they are definable in the Denef-Pas language) and then, by the transfer principles and Ngô's proof we can transfer the Fundamental Lemma from fields of positive characteristic to fields of characteristic zero.

The purpose of my talk is to present new results in this direction, the transfer principle for a general version of the Fundamental Lemma, for this result we established the motivic nature of the Satake transform and the transfer factors for the groups (these are important notions introduced by Langlands and Shelstad). As we will see in the talk, the proofs are basically the definability in the Denef-Pas language of all the ingredients in the identities of orbital integrals involved in this general form of the Fundamental Lemma. This is a joint work with Tom Hales.

[1] R. Cluckers and F. Loeser, *Constructible motivic functions and motivic integration*, ***Inventiones Mathematicae***, vol. 173 (2008), no. 1, pp. 23–121.
[2] R. Cluckers, T. C. Hales and F. Loeser, *Transfer principle for the Fundamental Lemma*, ***Stabilization of the Trace Formula, Shimura varieties, and arithmetic applications*** (Clozel, Harris, Labesse and Ngô, editors), International Press, Somerville, Massachusetts, U.S.A. 2011, pp. 309–348.

► DANIEL HOFFMANN, *Correlations between HS-derivations and the* $\mathrm{SCF}_{p,e}$.
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We will describe an idea of expanding the axiomatisation of the theory of separably closed fields given in [3]. Our axiomatisation differs from the one in [4]. It involves results for Hasse-Schmidt derivations obtained in [2] and [1]. Briefly, we are considering a multidimensional generalisation of HS-derivations with iterativity rules corresponding to a special algebraic group. A reduct of this generalisation matches our modification of axioms from [3].

[1] Daniel Hoffmann, *On existence of canonical G-bases*, submitted.
[2] Daniel Hoffmann, Piotr Kowalski, *Existentially closed fields with G-derivations*, submitted.
[3] Margit Messmer, Carol Wood, *Separably closed fields with higher derivation 1.*, ***The Journal of Symbolic Logic***, vol.60(3) (1995), pp.898–910.
[4] Martin Ziegler, *Separably closed fields with Hasse derivations*, ***The Journal of Symbolic Logic***, vol.68 (2003), pp.311–318.

► AIZHAN ALTAYEVA, BEIBUT KULPESHOV, *On orthogonality of a family of convex components of a type in weakly circularly minimal structures.*
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Here we continue studying the notion of *weak circular minimality* originally introduced in [1]. A *circular* order relation is described by a ternary relation K satisfying the following conditions:
(co1) $\forall x\forall y\forall z(K(x,y,z)\to K(y,z,x))$;
(co2) $\forall x\forall y\forall z(K(x,y,z)\wedge K(y,x,z)\Leftrightarrow x=y\vee y=z\vee z=x)$;
(co3) $\forall x\forall y\forall z(K(x,y,z)\to\forall t[K(x,y,t)\vee K(t,y,z)])$;
(co4) $\forall x\forall y\forall z(K(x,y,z)\vee K(y,x,z))$.

A circularly ordered structure $M=\langle M,K,\dots\rangle$ is *weakly circularly minimal* if any definable (with parameters) subset of M is a finite union of convex sets. The theory of weakly circularly minimal structures was developed in [1, 2, 3].

Definition 1. [1] Let M be a circularly ordered structure, $p\in S_1(\emptyset)$. We say p is *m-convex* if for any elementary extension N of M, $p(N)$ is the disjoint union of m maximal convex sets (which are called the *convex components* of $p(N)$). We say M is *m-convex* if every type $p\in S_1(\emptyset)$ is m-convex, and we say $Th(M)$ is *m-convex* if this holds for all $N\equiv M$.

Theorem 2. [1] *Let M be a weakly circularly minimal structure. Then there is $m<\omega$ such that M is m-convex.*

Let M be a weakly circularly minimal structure that is m-convex, and $p\in S_1(\emptyset)$ be non-algebraic. Then $p(M)=\cup_{i=1}^m U_i$, where each U_i is convex. Suppose that $K_0(U_1,\dots,U_m)$. We say that a family of convex components $\{U_1,\dots,U_s\}$ of p is *weakly orthogonal over* $\emptyset$ if every s-tuple $\langle a_1,\dots,a_s\rangle\in U_1\times\dots\times U_s$ satisfies the same type over $\emptyset$. We say that $\{U_1,\dots,U_s\}$ is *orthogonal over* $\emptyset$ if for any sequence $(n_1,n_2,\dots,n_s)\in\omega^s$ every $(n_1+n_2+\dots+n_s)$–tuple $\langle a_1^1,a_1^2,\dots,a_1^{n_1};\dots;a_2^1,a_2^2,\dots,a_2^{n_2};\dots;a_s^1,a_s^2,\dots,a_s^{n_s}\rangle\in(U_1)^{n_1}\times(U_2)^{n_2}\times\dots\times(U_s)^{n_s}$ with $K_0(a_1^1,a_1^2,\dots,a_1^{n_1};\dots;a_2^1,a_2^2,\dots,a_2^{n_2};\dots;a_s^1,a_s^2,\dots,a_s^{n_s})$ satisfies the same type over $\emptyset$.

We say that p has *convexity rank 1* ($RC(p)=1$) if there is no parametrically definable equivalence relation with infinitely many infinite convex classes in $p(M)$.

In [4] orthogonality of a family of pairwise weakly orthogonal non-algebraic 1-types over $\emptyset$ for $\aleph_0$-categorical weakly o-minimal theories of convexity rank 1 has been proved. Here we prove the following theorem:

Theorem 3. *Let M be an $\aleph_0$-categorical m-convex weakly circularly minimal structure, $m > 1$, $p \in S_1(\emptyset)$ be non-algebraic, $RC(p) = 1$. Suppose that a family of convex components $\{U_1, \dots, U_s\}$ of p is pairwise weakly orthogonal over $\emptyset$. Then it is orthogonal over $\emptyset$.*

[1] B.Sh. Kulpeshov, H.D. Macpherson, *Minimality conditions on circularly ordered structures*, ***Mathematical Logic Quarterly***, vol. 51 (2005), pp. 377–399.
[2] B.Sh. Kulpeshov, *On $\aleph_0$-categorical weakly circularly minimal structures*, ***Mathematical Logic Quarterly***, vol. 52 (2006), pp. 555–574.
[3] B.Sh. Kulpeshov, *Definable functions in the $\aleph_0$-categorical weakly circularly minimal structures*, ***Siberian Mathematical Journal***, vol. 50 (2009), pp. 282–301.
[4] B.Sh. Kulpeshov, *Binarity for $\aleph_0$-categorical weakly o-minimal theories of convexity rank 1*, ***Siberian Electronic Mathematical Reports***, vol. 3 (2006), pp. 185–196.

► ALFRED DOLICH, *"Generic" functions over divisible ordered abelian groups.*
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Let T be the theory of divisible ordered Abelian groups and let σ be a new unary function symbol. It is well known via [1] that the theory $T \cup$ "σ is an automorphism" does not have a model companion. In this talk we consider the weaker theory T_0 axiomatized by $T \cup$ "σ is a linear bijection". We show that T_0 has a model companion T_σ and study this theory, showing that modulo the fact that σ is a nonwhere continuous function that T_σ is as well-behaved as can be reasonably expected.

[1] H. Kikyo and S. Shelah, *The strict order property and generic automorphisms*, ***Journal of symbolic logic***, vol. 67, no. 1, pp. 214–216.

► DAVID NYIRI, *Robinson's property and amalgamations of higher arities.*
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As it is well-known, Craig's interpolation theorem and Robinson's joint consistency theorem are closely related results of classical logic. Continuing investigations on this topic initiated by Gyenis, we are going to study the following model theoretic version of Robinson's result. We say that a structure $\mathcal{M}$ satisfies the Robinson property if the union of two partial types p, q can be realized unless there is $\phi \in p$ with $\neg\phi \in q$. Our goal is to characterize homogeneous and universal structures $\mathcal{M}$ that satisfy Robinson's property. We provide such a characterization in terms of the finitely generated substructures of $\mathcal{M}$ (which is denoted by $age(\mathcal{M})$).

Our main results are as follows. We are going to introduce a sequence of generalized amalgamation properties $\mathsf{AP_n}$ for every natural number $n \geq 3$. The origin of our notions is the *prescribed amalgamation property* in [1] which coincides with our $\mathsf{AP_3}$ and it is a variation of the amalgamation property. It turns out that a universal and homogeneous structure $\mathcal{M}$ satisfies the Robinson property if and only if its age has both $\mathsf{AP_3}$ and $\mathsf{AP_4}$. In addition, we proved that in the case $\mathcal{M}$ satisfies Robinson's property, $age(\mathcal{M})$ has $\mathsf{AP_n}$ for any $n \geq 3$ and hence we can say that $\mathsf{AP_3} + \mathsf{AP_4} \Rightarrow \mathsf{AP_n}$.

[1] Zaln Gyenis, *Interpolation property and homogeneous structures*, ***The Journal of Interest Group of Pure Logic***, vol. 22 (2014), no. 4, pp. 597–607.

CONTRIBUTED TALKS – TUESDAY 4 AUGUST

► BEIBUT KULPESHOV, SERGEY SUDOPLATOV, DMITRIY YEMELYANOV, *On algebras of distributions for binary formulas of countably categorical weakly o-minimal theories.*
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We apply a general approach for distributions of binary formulas [1, 2, 3] to the class of countably categorical weakly *o*-minimal structures [4, 5, 6, 7].

Using Cayley tables we explicitly define the class of commutative monoids $\mathfrak{A}_n$ of isolating formulas for 1-types r of countably categorical weakly *o*-minimal theories with binary convexity rank $\mathrm{RC_{bin}}(r) = n$, or $(P, \aleph_0, n)$*-wom-monoids*. For an algebra $\mathfrak{P}_{\nu(r)}$ (see [1, 3] for the definition) of binary isolating formulas of 1-type r, we have

Theorem 1. *Let T be a countably categorical weakly o-minimal theory. Then for any type $r \in S^1(\emptyset)$ and a natural number n, the following conditions are equivalent:*
(1) *the algebra $\mathfrak{P}_{\nu(r)}$ is a $(P, \aleph_0, n)$-wom-monoid;*
(2) $\mathrm{RC_{bin}}(r) = n$.

Corollary 2. *Let T be a countably categorical o-minimal theory. Then for any non-algebraic type $r \in S^1(\emptyset)$, the algebra $\mathfrak{P}_{\nu(r)}$ is a $(P, \aleph_0, 1)$-wom-monoid.*

Definition 3. We say that an algebra $\mathfrak{P}_{\nu(\{p,q\})}$ (see [1, 3]) is *generalized commutative* if there is a bijection $\pi : \rho_{\nu(p)} \to \rho_{\nu(q)}$ witnessing that the algebras $\mathfrak{P}_{\nu(p)}$ and $\mathfrak{P}_{\nu(q)}$ are isomorphic (i.e., that their Cayley tables are equal up to π) and for any labels $l \in \rho_{\nu(p,q)}$, $m \in \rho_{\nu(q,p)}$, we have $\pi(l \cdot m) = m \cdot l$.

Theorem 4. *Let T be a countably categorical weakly o-minimal theory, $p, q \in S^1(\emptyset)$. Then the following conditions are equivalent:* (1) *the algebra $\mathfrak{P}_{\nu(\{p,q\})}$ is a generalized commutative monoid;* (2) $\mathrm{RC_{bin}}(p) = \mathrm{RC_{bin}}(q)$.

[1] I.V. Shulepov and S.V. Sudoplatov, *Algebras of distributions for isolating formulas of a complete theory*, ***Siberian Electronic Mathematical Reports***, vol. 11 (2014), pp. 362–389.
[2] S.V. Sudoplatov, *Algebras of distributions for semi-isolating formulas of a complete theory*, ***Siberian Electronic Math. Reports***, vol. 11 (2014), pp. 408–433.
[3] ———, ***Classification of countable models of complete theories***, Novosibirsk State Technical University, Novosibirsk, 2014.
[4] H.D. Macpherson, D. Marker, and C. Steinhorn, *Weakly o-minimal structures and real closed fields*, ***Transactions of The American Mathematical Society***, vol. 352 (2000), pp. 5435–5483.
[5] B.Sh. Kulpeshov, *Weakly o-minimal structures and some of their properties*, ***The Journal of Symbolic Logic***, vol. 63 (1998), pp. 1511–1528.
[6] B.S. Baizhanov, *Expansion of a model of a weakly o-minimal theory by a family of unary predicates*, ***The Journal of Symbolic Logic***, vol. 66 (2001), pp. 1382–1414.
[7] B.Sh. Kulpeshov, *Criterion for binarity of $\aleph_0$-categorical weakly o-minimal theories*, ***Annals of Pure and Applied Logic***, vol. 45 (2007), no. 2, pp. 354–367.

CONTRIBUTED TALKS 2

Tuesday, 4 August • 4.00PM–6.00PM
Venue - PII

▸ BAHAREH AFSHARI, STEFAN HETZL, AND GRAHAM E. LEIGH, *Confluence of cut elimination with respect to Herbrand disjunctions*.
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Herbrand's theorem, in its simplest form, states that an existential formula $\exists x F$ (with F quantifier-free) is valid if and only if there exist terms $t_0, \ldots, t_k$ such that $\bigvee_{i \le k} F(t_i)$ is a tautology. A constructive proof of Herbrand's theorem allows us to view cut elimination as an algorithm for witness extraction: given a proof π of $\exists x F$ in classical first-order logic, one applies cut-elimination to obtain a cut-free proof π' from which the desired witnesses and the propositional proof are easily extracted.

It is well known that cut elimination for sequent calculus is strongly non-confluent, with the number of different Herbrand disjunctions derivable from a single proof with cut growing at least as fast as the size of the cut-free proofs. However, it remains an open question whether cut-elimination can yield infinitely many different Herbrand disjunctions for a given proof.

We consider first-order proofs with cuts of complexity at most Π_2 and show that for a large (and natural) class of reduction strategies we have Herbrand confluence: all (possibly infinitely many) normal forms of a proof obtainable by these reductions provide the same Herbrand disjunction.

The result depends on a novel connection between cut elimination and formal language theory. To each Π_2-proof π we assign a formal tree grammar such that i) the number of production rules is bounded by the size of π, ii) the size of its language is at most double exponential in the size of π, and iii) the language of the grammar is a set of terms inducing a Herbrand disjunction for the end-sequent of π. Herbrand confluence is proved by showing that the language of this canonical grammar is invariant under most cut reduction steps.

▸ ANNIKA SIDERS, *Gentzen's ordinal collapsing function*.
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Gentzen's 1938 consistency proof was published in [1]. An English translation was published in [2] and a presentation with detailed ordinal calculations was published in [3]. The proof idea of the consistency proof can be summarised in 5 steps:

1. Derivations in Sequent Calculus are inductively defined top-down and an inconsistent derivation is assumed to be given.
2. A cumulative complexity measure for sequents, the height, is calculated bottom-up in the given derivation.
3. A reduction procedure is applied on the derivation.
4. The ordinal of both the given and reduced derivations are calculated to confirm that the reduction procedure reduces the complexity, measured by the ordinal.
5. The application of the reduction procedure with corresponding decreasing ordinals may continue indefinitely.
6. The impossibility of an inconsistent derivation is concluded.

The outline for the proof shows a clear order of dependency: The ordinal of a derivation depends on the height of sequents, the height measure depends on the given derivation. The fact that derivations are defined top-down and the height is measured bottom-up leads to the requirement that the derivation under consideration has to be fixed in order to determine the ordinal. If the derivation was extended, then the heights of all sequents could change, thus altering the ordinal assigned to the previously fixed subderivation.

However, if the controlled rearrangement of heights, the so called height-line argument, is extracted from Gentzen's ordinal assignment, then a purely top-down ordinal assignment for derivations can be given. This extraction results in a shift of dependencies. The derivation and its ordinal can be given simultaneously. After the derivation has been fixed and all potential reduced derivations can be produced, then the height-line argument can be applied through an ordinal collapse. It can be proven that Gentzen's ordinal collapsing function collapses the ordinal of the top-down ordinal assignment to the ordinal of Gentzen's ordinal assignment.

[1] G. Gentzen, *Neue Fassung des Widerspruchsfreiheitsbeweises für die reine Zahlentheorie*, ***Forschungen zur Logik und zur Grundlegung der exakten Wissenschaften***, vol. 4 (1938), pp. 19–44.

[2] M.E. Szabo, editor. ***The Collected Papers of Gerhard Gentzen***, North-Holland publishing company, Amsterdam, 1969.

[3] G. Takeuti, ***Proof Theory***, Dover Books on Mathematics, Dover Publications, 2013 (second edition).

▸ BRANISLAV BORIČIĆ, *On normalization theorem for superintuitionistic logics*.
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The paper [1] opened a possibility to obtain a separable and normalizable natural deduction system for classical logic, and to extend the same method to classical logic subsystems, superintuitionistic logics, as in [2], and its implicative fragment, as in [4]. On the other hand, it is shown (see [3]) that each sequent provable in a superintuitionistic logic L has the corresponding cut–free L–proof. By using approaches [1] and [4], we can conclude, from [3], that for each superintuitionistic logic L and each natural L–derivation, there exists the corresponding normal natural L–derivation.

[1] B. Boričić, *On sequence–conclusion natural deduction systems*, ***Journal of Philosophical Logic***, vol. 14 (1985), pp. 359-377.

[2] B. Boričić, *On certain normalizable natural deduction formulations of some propositional intermediate logics*, ***Notre Dame Journal of Formal Logic***, vol. 29 (1988), pp. 563-568.

[3] B. Boričić, *A note on sequent calculi intermediate between LJ and LK*, ***Studia Logica***, vol. 47 (1988), pp. 151-157.

[4] B. Boričić, M. Ilić, *An alternative normalization of the implicative fragment of classical logic*, ***Studia Logica***, vol. 103 (2015), pp. 413-446.

▸ HENRIK FORSSELL, *Constructive completeness and non-discrete languages*.
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The basic development of logic in a constructive setting often assumes that signatures are discrete. That is, that one can decide whether two symbols are the same or not. However, standard constructions, such as extending a language with that of an arbitrary structure or category, motivates considering the development of logic with non-discrete signatures. We set down a few non-discrete versions of standard logical constructions, and use these to show several constructive completeness theorems for non-discrete theories of first-order and fragments of first-order logic. The completeness theorems flow from a unified, categorical approach to Kripke and Beth-style models based on a theorem by A. Joyal. With this we can give new proofs of classical constructive completeness theorems, such as that of [1], and give extensions of these to the non-discrete case. In particular, we show completeness theorems for disjunction-free theories with respect to exploding Kripke models and for first-order theories with

CONTRIBUTED TALKS – TUESDAY 4 AUGUST

respect to exploding "Beth-like" models. Both without placing restrictions on the size or discreteness of the language. From the former one obtains e.g. the disjunction property for disjunction-free theories as a straightforward corollary. A specialization of the latter yields a constructive version of the Beth-completeness theorem of [2]. This is joint work with C. Espindola and P.L. Lumsdaine.

[1] Wim Veldman, *An Intuitionistic Completeness Theorem for Intuitionistic Predicate Logic*, ***Journal of Symbolic Logic***, vol. 4 (1976), no. 1, pp. 159–166.

[2] Dov M. Gabbay, *A New Version of Beth Semantics for Intuitionistic Logic*, ***Journal of Symbolic Logic***, vol. 42 (1977), no. 2, pp. 306–308.

▸ RYOTA AKIYOSHI AND YUTA TAKAHASHI, *A Uniform Idea behind Gentzen's Three Consistency Proofs*.
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Gentzen, in his first two consistency proofs, gave a constructive interpretation that covers all propositions of first-order arithmetic, while he did not present his interpretation explicitly. In this talk, first we formulate Gentzen's constructive interpretation through examining both the details of his first two consistency proofs and the relevant passages from his papers. Second, we introduce a framework for joining Gentzen's constructive interpretation with a contemporary method of proof theory, namely, Mints-Buchholz's method of *finite notation for infinitary derivations*. A key to the framework is the notion of *normalization trees* introduced in [1]. On the basis of the observations in [2, 1], we simulate Gentzen's constructive interpretation in the framework of normalization trees. Furthermore, we explain his third consistency proof in this framework as well, by utilizing the analysis made in [3]. A consequence of our argument is that the formulation of a constructive interpretation is a uniform idea behind Gentzen's three consistency proofs.

[1] Ryota Akiyoshi, *Gentzen's First Consistency Proof Revisited*, ***CARLS Series of Advanced Study of Logic and Sensibility Vol.4***, Keio University, 2010.

[2] Toshiyasu Arai, *Review: Three papers on proof theory by W. Buchholz and S. Tupailo*, ***The Bulletin of Symbolic Logic***, vol. 8 (2002), pp. 437–439.

[3] Wilfried Buchholz, *Explaining Gentzen's consistency proof within infinitary proof theory*, ***Computational Logic and Proof Theory: 5th Kurt Gödel Colloquium, KGC'97*** (G. Gottlob, A. Leitsch and D. Mundici, editors), Springer, Berlin, 1997, pp. 4–17.

Some partial conservativity properties for Intuitionistic Set Theory with the principle P

Let $\mathbb{ZFI}2C$ be usual intuitionistic Zermelo-Fraenkel set theory in two-sorted language (where sort 0 is for natural numbers, and sort 1 is for sets).

Axioms and rules of the system are: all usual axioms and rules of Heyting predicate logic, intuitionistic arithmetic, and all usual proper axioms and schemes of Zermelo-Fraenkel set theory for variables of sort 1, witn schemes Transfinite Induction as Regularity, and Collection as Substitution.

It is well-known that both $\mathbb{ZFI}2C$ and $\mathbb{ZFI}2C + DCS$ (where DCS is a well-known principle Double Complement of Sets) have some important properties of effectivity: disjunction property, numerical existence property (but not full existence property!) and also that the Markov Rule, the Church Rule, and the Uniformization Rule are admissible in it. Such collection of existence properties shows that these theories are sufficiently constructive theories.

On the other hand, $\mathbb{ZFI}2C + DCS$ contains the classical theory $\mathbb{ZF}2$ (i.e. $\mathbb{ZFI}2C{+}LEM$) in the sense of Gödel's negative translation. Moreover, a lot of important mathematical reasons may be formalized in $\mathbb{ZFI}2C + DCS$, so, we can formalize and decide in it a lot of informal problems about transformation of a classical reason into intuitionistical proof and extraction of a description of a mathematical object from some proof of it's existence.

So, $\mathbb{ZFI}2C + DCS$ can be considered as a basic system of Explicit Set Theory. We can extend it by a well-known intuitionistic principles, as Markov Principle M, Extended Church Thesis (ECT), the Principle UP, and the Principle P..

It is well-known that both $\mathbb{ZFI}2C + DCS + M + ECT$, and $\mathbb{ZFI}2C + DCS + M$ has the same effectivity properties as $\mathbb{ZFI}2C$ and $\mathbb{ZFI}2C + DCS$.

It is known also that $\mathbb{ZFI}2C + DCS + M + ECT$ is conservative over $\mathbb{ZFI}2C + DCS + M$ w. r. t. class AEN of all formulae of kind $\forall a \exists b \vartheta(a; b)$, where $\vartheta(a; b)$ is a arithmetical negative (in the usual sense) formula. We also have that $\mathbb{ZFI}2C + M + ECT$ is conservative over the theory $\mathbb{ZFI}2C + M$ w. r. t. the same class of formulae, where ECT is the usual schema of the Extended Church Thesis.

The Principle $UP : \forall x \exists a \psi(x; a) \to \exists a \forall x \psi(x; a)$ is a well-known specifical intuitionistic principle. It claims that we can't define effectivly non-trivial function from sets to natural numbers. It havs been studed in intuitionistic type theory.

The principle P is another well-known specifical intuitionistic principle.

In the article we prove that $\mathbb{ZFI}2C + DCS + M + CT + UP + P$ is conservative over the theory $\mathbb{ZFI}2C + DCS + M$ w. r. t. the class AEN. Sure, we also prove that $\mathbb{ZFI}2C + M + ECT + P$ is conservative over the theory $\mathbb{ZFI}2C + M$ w. r. t. the same class of formulae.

We also prove that theories $\mathbb{ZFI}2C + DCS + M + CT + UP$, $\mathbb{ZFI}2C + DCS + M + UP$, $\mathbb{ZFI}2C + DCS + UP$, and $\mathbb{ZFI}2C + UP$ have the same effectivity properties as $\mathbb{ZFI}2C$ and $\mathbb{ZFI}2C + DCS$.

CONTRIBUTED TALKS 3

Tuesday, 4 August • 4.00PM–6.00PM
Venue - PIII

▸ JOAN BAGARIA, *Large cardinals and the ordinal topological completeness of GLP.*
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We give a (probably exact) large cardinal lower bound for the completeness under ordinal topological semantics of the polymodal provability logic GLP (Japaridze [2]. See also Beklemishev-Gabelaia [1]). The needed large cardinal lays consistency-wise strictly above the first reflection cardinal (Mekler-Shelah [3]) and strictly below the first totally indescribable cardinal.

[1] Lev Beklemishev and David Gabelaia *Topological completeness of the provability logic GLP*, ***Annals of Pure and Applied Logic***, vol. 164 (12) (2013), pp. 1201–1223.

[2] Giorgi K. Japaridze *The polymodal logic of provability.* In ***Intensional Logics and Logical Structure of Theories: Material from the fourth Soviet–Finnish Symposium on Logic, Telavi, May 20–24,1985***. Metsniereba, Tbilisi (1988), pp. 16–48.

[3] Alan Mekler and Saharon Shelah, *The consistency strength of "every stationary set reflects"*, ***Israel Journal of Mathematics***, vol. 67 (1989), pp. 353–366.

▸ HAIM HOROWITZ AND SAHARON SHELAH, *Forcing, regularity properties and the axiom of choice.*
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We consider general regularity properties associated with Suslin ccc forcing notions. By Solovay's celebrated work, starting from a model of $ZFC+$"There exists an inaccessible cardinal", we can get a model of $ZF+DC+$"All sets of reals are Lebesgue measurable and have the Baire property". By another famous result of Shelah, $ZF+DC+$"All sets of reals have the Baire property" is equiconsistent with ZFC. This result was obtained by isolating the notion of "sweetness", a strong version of ccc which is preserved under amalgamation, thus allowing the construction of a suitably homogeneous forcing notion.

The above results lead to the following question: Can we get a similar result for non-sweet ccc forcing notions without using an inaccessible cardinal?

In our work we give a positive answer by constructing a suitable ccc creature forcing and iterating along a non-wellfounded homogeneous linear order. While the resulting model satisfies $ZF+\neg AC_\omega$, we prove in a subsequent work that starting with a model of $ZFC+$"There is a measurable cardinal", we can get a model of $ZF+DC_{\omega_1}$.

▸ HAZEL BRICKHILL, *A generalisation of closed unbounded sets.*
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A generalisation of stationarity, associated with stationary reflection, was introduced in [1]. I give an alternative characterisation of these n-stationary sets by defining a generalisation of closed unbounded (club) sets, so an n-stationary set is defined in terms of these n-clubs in the usual way. I will then look into what familiar properties of stationary and club sets will still hold in this more general setting, and explore the connection between these concepts and indescribable cardinals. Many of the simpler properties generalise completely, but for others we need an extra assumption. For instance to generalise the splitting property of stationary sets we have:

Theorem 1. *If κ is Π^1_{n-1} indescribable, then any n-stationary subset of κ is the union of κ many pairwise-disjoint n-stationary sets.*

In L these properties generalise straightforwardly as there any cardinal which admits an n-stationary set is Π^1_{n-1} indescribable (see [1]).

If there is time I will also introduce a generalisation of ineffable cardinals and a weak $\diamond$ principal that is associated.

Key words and phrases: 03E55, 03E05, 03E10, 03E45, 03E35 Stationary reflection, indescribable cardinal, ineffable cardinals, constructible universe

[1] Bagaria, J., M. Magidor, and H. Sakai, *Reflection and indescribability in the constructible universe.*, ***Israel Journal of Mathematics***, to appear (2012).

▸ ZACHIRI MCKENZIE, *Initial segments of models of set theory defined by non-trivial automorphisms.*
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In this talk I will report ongoing work being done in collaboration with Ali Enayat.

Interest in models of subsystems and extensions of ZFC that admit non-trivial automorphism and the specific behavior of these automorphisms arises both from a quest to better understand the model theory of set theory and from the deep connection established [4] between this subject and the alternative set theory NFU. More specifically, models of NFU can be built form models of subsystems of ZFC which admit non-trivial automorphism. "Good behavior" of the automorphism used in this construction often corresponds to analogues of large cardinal axioms holding in the model of NFU [3], and the theory which holds in the canonical interpretation of well-founded set theory inside the NFU model corresponds to the largest initial segment of the model of the subsystem of ZFC that is pointwise fixed by the automorphism [1]. This later connection is one of the motivations for our investigation of initial segments of models of subsystems of ZFC that can appear as the largest initial segment pointwise fixed by some non-trivial automorphism.

In this talk I will outline how the construction developed in [2] can be modified for set theory. This technique can be used to show that a cut of a model of set theory that satisfies a certain fragment of ZFC and for which there is no least cardinal above the cut, can appear as the largest initial segment of a model of set theory that is pointwise fixed by a non-trivial automorphism. We apply this construction to classify the transitive well-founded sets that can appear as the largest initial segment of a model of set theory that is pointwise fixed by a non-trivial automorphism. I will conclude the talk by highlighting some open questions and discussing some further avenues of research.

[1] Ali Enayat, *Automorphisms, Mahlo cardinals, and NFU*, ***Nonstandard Models of Arithmetic and Set Theory*** (Ali Enayat and Roman Kossak, editors), Contemporary Mathematics Series. vol. 361, American Mathematical Society, 2004, pp. 37–60.

[2] Ali Enayat, *Automorphisms of models of bounded arithmetic*, ***Fundamenta***

Mathematicae, vol. 192 (2006), pp. 37–65.
[3] Randall Holmes, *Strong Axioms of Infinity in NFU*, ***Journal of Symbolic Logic***, vol. 66 (2001), no. 1, pp. 87–116.
[4] Ronald B. Jensen, *On the Consistency of a Slight (?) Modifcation of Quine's New Foundations*, ***Synthese***, vol. 19 (1969), no. 1, pp. 250–263.

▸ JUAN CARLOS MARTÍNEZ, *On thin-tall and thin-thick Boolean spaces.*
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Recall that a topological space X is *scattered.* if every non-empty subspace of X has an isolated point. If X is a scattered Boolean space and α is an ordinal, we denote by $I_\alpha(X)$ the α^{th}-Cantor-Bendixson level of X, i.e. $I_\alpha(X) =$ set of isolated points of $X \setminus \bigcup\{I_\beta(X) : \beta < \alpha\}$. The *height of* X is defined by $\mathrm{ht}(X) =$ the least ordinal α such that $I_\alpha(X)$ is finite. And *the cardinal sequence of* X is defined by $\mathrm{CS}(X) = \langle |I_\alpha(X)| : \alpha < \ \mathrm{ht}(X)\rangle$.

If α is an ordinal, we put $\mathcal{C}(\alpha) = \{\mathrm{CS}(X) : X$ is a scattered Boolean space of height $\alpha\}$. If κ is an infinite cardinal and α is an ordinal, we denote by $\langle\kappa\rangle_\alpha$ the constant κ sequence of length α. And if f and g are sequences of infinite cardinals, we denote by $f^\frown g$ the concatenation of f with g. If X is a scattered Boolean space and κ is an infinite cardinal, we say that X is *κ-thin-tall*, if $\mathrm{CS}(X) = \langle\kappa\rangle_\alpha$ for some ordinal $\alpha \geq \kappa^+$. And we say that X is *κ-thin-thick*, if $\mathrm{CS}(X) = \langle\kappa\rangle_\kappa {}^\frown\langle\lambda\rangle$ for some cardinal $\lambda > \kappa$.

It is well-known that $\langle\omega\rangle_\alpha \in \mathcal{C}(\alpha)$ for every ordinal $\alpha < \omega_2$ and that it is relatively consistent with ZFC that $\langle\omega\rangle_\alpha \in \mathcal{C}(\alpha)$ for every ordinal $\alpha < \omega_3$. Also, it was shown by Baumgartner that $\langle\omega_1\rangle_{\omega_1} {}^\frown\langle\omega_2\rangle \notin \mathcal{C}(\omega_1 + 1)$ in the Mitchell Model. And it was shown by Koepke and Martínez that if $V = L$ holds then for every regular cardinal κ, $\langle\kappa\rangle_{\kappa^+} \in \mathcal{C}(\kappa^+)$ and $\langle\kappa\rangle_\kappa {}^\frown\langle\kappa^+\rangle \in \mathcal{C}(\kappa+1)$. However, no result is known on the existence of κ-thin-tall or κ-thin-thick spaces where κ is a singular cardinal.

Then, we shall present here a general construction of scattered Boolean spaces with a large top. As consequences of this construction, we obtain the following results:

1. If κ is a singular cardinal of cofinality ω, then $\langle\kappa\rangle_\kappa {}^\frown\langle\kappa^\omega\rangle \in \mathcal{C}(\kappa + 1)$.
2. If κ is an inaccessible cardinal, then $\langle\kappa\rangle_\kappa {}^\frown\langle\kappa^\kappa\rangle \in \mathcal{C}(\kappa + 1)$.
3. If GCH holds, then for every infinite cardinal κ we have $\langle\kappa\rangle_\kappa {}^\frown\langle\kappa^{\mathrm{cf}(\kappa)}\rangle \in \mathcal{C}(\kappa+1)$.

Also, we shall present some results and open problems on the existence of thin-tall spaces in relation to large cardinals.

▸ VLADIMIR KANOVEI, *Some applications of finite-support products of Jensen's minimal Δ^1_3 forcing.*
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Jensen [5] introduced a forcing notion $P \in \mathrm{L}$ such that any P-generic real a over L has minimal L-degree, is Δ^1_3 in $\mathrm{L}[a]$, and is the only P-generic real in $\mathrm{L}[a]$. Further applications of this forcing include iterations [1], finite products and finite-support infinite products for symmetric choiceless models [2, 4], et cetera. We present some new applications of finite-support infinite products of Jensen's forcing and its variations.

Theorem 1 (with V. Lyubetsky). *There is a generic extension* $\mathrm{L}[a]$ *of* L *by a real in which* $[a]_{\mathsf{E}_0}$ *is a countable lightface* Π^1_2 *set not containing any ordinal-definable reals.*

Recall that E_0 is an equivalence relation on ω^ω such that $x \mathrel{\mathsf{E}_0} y$ iff $x(k) = y(k)$ for all but finite k, and $[a]_{\mathsf{E}_0} = \{b \in \omega^\omega : a \mathrel{\mathsf{E}_0} b\}$ is the (countable) E_0-class of a real $a \in \omega^\omega$.

Let a *Groszek – Laver pair* be any OD (ordinal-definable) pair of sets $X, Y \subseteq \omega^\omega$ such that neither of X, Y is separately OD. As demonstrated in [3], if $\langle x, y\rangle$ is a Sacks×Sacks generic pair of reals over L then their L-degrees $X = [x]_{\mathrm{L}} \cap \omega^\omega$ and $Y = [y]_{\mathrm{L}} \cap \omega^\omega$ form such a pair in $\mathrm{L}[x, y]$; the sets X, Y is this example are obviously uncountable.

Theorem 2 (with M. Golshani and V. Lyubetsky). *There is a generic extension* $\mathrm{L}[a, b]$ *of* L *by reals* a, b *in which it is true that the countable sets* $[a]_{\mathsf{E}_0}$ *and* $[b]_{\mathsf{E}_0}$ *form a Groszek – Laver pair, and moreover the union* $[a]_{\mathsf{E}_0} \cup [b]_{\mathsf{E}_0}$ *is a lightface* Π^1_2 *set.*

Theorem 3 (with V. Lyubetsky). *It is consistent with* **ZFC** *that there exists a lightface* Π^1_2 *set* $\emptyset \neq Q \subseteq \omega^\omega \times \omega^\omega$ *with countable cross-sections* $Q_x = \{y : \langle x, y\rangle \in Q\}$, $x \in \omega^\omega$, *non-uniformizable by any ROD set. In fact each cross-section* Q_x *in the example is a* E_0 *class.*

ROD = real-ordinal-definable. Typical examples of non-ROD-uniformizable sets, like $\{\langle x, y\rangle : y \notin \mathrm{L}[x]\}$ in the Solovay model, definitely have **un**countable cross-sections.

[1] Uri Abraham, *A minimal model for* $\neg CH$ *: iteration of Jensen's reals*, ***Transactions of the American Mathematical Society***, vol. 281 (1984), pp. 657–674.
[2] Ali Enayat, *On the Leibniz-Mycielski axiom in set theory*, ***Fundamenta Mathematicae***, vol. 181 (2004), no. 3, pp. 215–231.
[3] M. Groszek and R. Laver, *Finite groups of OD-conjugates*, ***Periodica Mathematica Hungarica***, vol. 18 (1987), pp. 87–97.
[4] Vladimir Kanovei, *On the nonemptiness of classes in axiomatic set theory*, ***Mathematics of the USSR-Izvestiya***, vol. 12 (1978), no. 3, pp. 507–535.
[5] Ronald Jensen, *Definable sets of minimal degree*, ***Mathematical Logic and Foundations of Set Theory, Proceedings of an International Colloquium*** (Jerusalem 1968), (Yehoshua Bar-Hillel, editor), North-Holland, 1970, pp. 122–128.

CONTRIBUTED TALKS 4

Tuesday, 4 August • 4.00PM–6.00PM
Venue - PIV

▸ AHMAD KARIMI, *Yablo's paradox(es) as theorem(s) in temporal Logic.*
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This is a joint work with Saeed Salehi.

Paradoxes are interesting puzzles in philosophy and mathematics. They can be more interesting when they turn into genuine theorems. For example, Russell's paradox which collapsed Frege's foundations of mathematics, is now a classical theorem in set theory, implying that no set of all sets can exist. Or, as another example, the Liar paradox has turned into Tarski's theorem on the undefinability of truth in sufficiently rich languages. This paradox also appears implicitly in the proof of Gödel's first incompleteness theorem. For this particular theorem, some other paradoxes such as Berry's ([1, 2]) or Yablo's ([7, 8]) have been used to give alternative proofs ([4, 6]). A more recent example is the surprise examination paradox [3] that has turned into a beautiful proof for Gödel's second incompleteness theorem ([5]). In this talk, we transform Yablo's paradox into a theorem in the Linear Temporal Logic (LTL). This paradox, which is the first one of its kind that supposedly avoids self–reference and circularity has been used for proving an old theorem ([4, 6]) but not a new theorem had been made out of it. Here, for the very first time, we use this paradox (actually its argument) for proving some genuine mathematical theorems in LTL. The thought is that we can make progress by thinking of the sentences in the statement of Yablo's paradox not as an infinite family of atomic propositions but as a single proposition evaluated in lots of worlds in a Kripke model. Thus the derivability of Yablo's paradox should be the same fact as the theoremhood of a particular formula in the linear temporal logic. This temporal treatment also unifies other versions of Yablo's paradox.

[1] Georg Boolos, *A New Proof of the Gödel Incompleteness Theorem*, ***Notice of the American Mathematical Society*** 36 (1989) 388–390.

[2] Gregory J. Chaitin, *Information-Theoretic Limitations of Formal Systems*, ***Journal of Association for Computing Machinery*** 21 (1974) 403–424.

[3] Timothy Y. Chow, *The Surprise Examination or Unexpected Hanging Paradox*, ***The American Mathematical Monthly*** 105 (1998) 41–51.

[4] Cezary Cieśliński & Rafael Urbaniak, *Gödelizing the Yablo Sequence*, ***Journal of Philosophical Logic*** 42 (2013) 679–695.

[5] Shira Kritchman & Ran Raz, *The Surprise Examination Paradox and the Second Incompleteness Theorem*, ***Notice of the American Mathematical Society*** 57 (2010) 1454–1458.

[6] Graham Leach-Krouse, *Yablifying the Rosser Sentence*, ***Journal of Philosophical Logic*** 43 (2014) 827–834.

[7] Stephen Yablo, *Truth and Reflection*, ***Journal of Philosophical Logic*** 14 (1985) 297–349.

[8] Stephen Yablo, *Paradox without Self-Reference*, ***Analysis*** 53 (1993) 251–252.

▸ TED SHEAR, *Lockean danger zones and lossy inferences.*
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In this paper, I provide precise bounds on the prior credences of an agent with both credences and qualitative beliefs that allow her to revise her qualitative beliefs by AGM revision and not be led from a credal/belief state satisfying the Lockean thesis to another that fails to. More precisely, suppose an agent possesses a probabilistic credence function $b(\cdot)$ updated by conditionalization – *i.e.* $b'(\cdot) = b(\cdot \mid E)$ – and a belief set $\mathbf{B}$ updated by AGM's partial-meet revision – *i.e.* $\mathbf{B}' = \mathbf{B} * E$. Additionally, suppose that her credal/belief state satisfies the Lockean thesis: $p \in \mathbf{B}$ iff $b(p) > t$. I establish bounds on the assignments of $b(\cdot)$ that identify a region surrounding t – called a *Lockean danger zone* – such that $p \in \mathbf{B} * E$ iff $b(\cdot \mid E) > t$.

The bounds on the Lockean danger zone are generated from the probabilistic bounds on the lossy inferences of the rational consequence relation (RCR) that have been established in the literature, which are nicely summarized in [1]. The bounds on a lossy inference rule provide the lowest probability that can be coherently assigned to the conclusion of an inference rule relative to the probabilities of the premises. A transformation of these bounds into an upper bound on the probabilities that can be assigned to the premises of such a rule relative to the probability of the conclusion provide basis for determining how far away the probabilities in the premises would need to be from t in order for an agent to never be led by the RCR to a conclusion below t. Given the well-known equivalence between the RCR and AGM, this transformation determines the Lockean danger zone. Of particular interest is the treatment of the non-Horn condition in Rational Monotony. The establishment of the Lockean danger zone may be seen as one important step towards bridging the qualitative/quantitative divide.

[1] David Makinson and James Hawthorne, *Lossy Inference Rules and Their Bounds: A Brief Review*, ***The Road to Universal Logic*** (Arnold Koslow and Arthur Buchsbaum, editors), Springer International Publishing, Switzerland, 2015, pp. 385–407.

▸ FARSHAD BADIE & HANS GÖTZSCHE, *Towards a Formal Occurrence Logic based on Predicate Logic.*
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In this discussion we will concentrate on the main characteristics of our alternative kind of logic: *Occurrence Logic*, which is not based on truth functionality [1]. We have also taken into account temporal logic developed and elaborated by *A. N. Prior* [4,5,7].

We will focus on characterising arguments based on formal Occurrence Logic concerning events and occurrences, and illustrate the relations between Predicate Logic and Occurrence Logic. The relationships (and dependencies) is conducive to an approach that can analyse the occurrences of 'logical statements based on different logical principles' at different moments. We shall conclude that our approach could be able to support us in providing a truth-functionally independent formal logic that could focus on formal Semantics based on events and occurrences.

[1] Götzsche, Hans, *Deviational Syntactic Structures. London / New Delhi / New York / Sydney: Bloomsbury Academic, 2013.*

[2] Engelfriet, Joeri and Treur, *Linear Branching Time and Joint Closure Semantics for Temporal Logic. J. Logic, Language and Information, 2002.*

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[5] Prior, Arthur N, *Past, Present and Future. Oxford University Press, 1967.*

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[7] Øhrstrøm, Peter and Per Hasle, *Temporal Logic. Dordrecht /Boston / London: Kluwer, 1995.*

[8] Hardegree, Gary, *Completeness and super-valuations, J. Philosophical Logic, 2005.*

[9] Emerson, *Handbook of Theoretical Computer Science, Temporal and Modal Logic, Elsevier Science, 1990.*

[10] vanFraassen, *Formal Semantics and Logic, Macmillan, 1971.*

[11] Jacquette, D, *A Companion to Philosophical Logic. Oxford: Blackwell, 2002.*

▸ MARTA BÍLKOVÁ, ONDREJ MAJER, *Epistemic logics for sceptical agents.*
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We present a multiagent extension of an epistemic logic introduced in [1]. Its framework is based on an epistemic modality of knowledge defined as a diamond operator over distributive non-associative full Lambek calculus with a negation. We deal with the relational semantics for distributive substructural logics of [3], interpreting the elements of a relational frame as information states consisting of collections of data which may be incomplete or even inconsistent. The principal epistemic relation between the states is the one of being a reliable source of information, on the basis of which we explicate the notion of knowledge as *information confirmed by a reliable source* — an information state which precedes the current state and is compatible with it. From this point of view it is natural to define the epistemic operator existentially as a (backward-looking) diamond modality. The system is modular in the sense that the axiomatization of the epistemic operator is sound and complete with respect to a wide class of background propositional logics, which makes the system potentially applicable to a wide class of epistemic contexts.

The original system of [1] admits a weak form of logical omniscience (the monotonicity rule), but avoids stronger ones (the necessitation rule and the K-axiom) as well as some closure properties discussed in normal epistemic logics (like the positive and negative introspection). For these properties we provided characteristic frame conditions, so that they can be present in the system if they are considered to be appropriate for some specific epistemic context. Finally, we discuss even weaker variants of the epistemic logic, avoiding some properties concerning disjunction (in particular the knowledge modality distributing over disjunction, or the propositional distributivity law).

[1] Bílková, M., O. Majer and M. Peliš, *Epistemic logics for sceptical agents*, ***Journal of Logic and Computation***, first published online March 21, 2015.

[2] Bílková, M., O. Majer, M. Peliš and G. Restall, *Relevant agents*, ***Advances in Modal Logic*** (L. Beklemishev, V. Goranko and V. Shehtman, editors) College Publications, 2010, pp. 22–38.

[3] Restall, G., ***An Introduction to Substructural Logics***, Routledge, 2000.

▸ URSZULA WYBRANIEC-SKARDOWSKA, *Categories of first order quantifiers*.
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The paper refers to some innovative ideas of Gottlob Frege [1884], visible in the syntactic and semantic categorial agreement of language expressions, i.e. in *the principle* (*CA*) *of categorial compatibility*, based on the agreement of the syntactic category of each language expression with the ontological category assigned to its denotatum. The principle (*CA*) of syntactic and semantic, i.e. also ontological categorial agreement, can be given by keeping, for any expression e of a categorial language, the relationship:

(CA) $$e \in CAT\iota \text{ iff } d(e) \in ONT\iota,$$

where $CAT\iota$ and $ONT\iota$ are, respectively, the category: syntactic and ontological with the index ι, and d is the function of denotation, defined on the set of all simple and functor-argument expressions of this language and with the values in the family of all ontological categories satisfying the condition of homomorphism (the principle of compositionality of denotation): If $e = f(e_1, e_2, \dots, e_n)$, then

$$d(f(e_1, e_2, \dots, e_n)) = d(f)(d(e_1), d(e_2), \dots, d(e_n));$$

f is here the main functor of the expression e, and $e_1, e_2, \dots, e_n$ - are arguments of this functor-function.

The unsatisfactory efforts to establish, in the sense of (CA), the category of quantifiers in formalized first order languages can be solved as follows. Let

Var be the set of all individual variables, with categorial index n_1;

S - the set of all sentences, with the categorial index s;

S_k ($k \geq 1$) - the set of all sentential functions in which exactly k free variables occur, with the index s_k.

In Fregean semantics we assume that

$$d(x) \in \{U\} = ONTn_1 \qquad \text{for any } x \in CATn_1 = Var,$$
$$d(p) \in \{0,1\} = ONTs \qquad \text{for any } p \in CATs = S,$$
$$d(sf) \in 2^{U^k} = ONTs_k \qquad \text{for any } sf \in CATs_k = S_k,$$
$$\text{for any functor } f \in CATa/b_1b_2...b_k = CATa^{CATb_1 \times CATb_2 \times \ldots \times CATb_k}$$
$$d(f) \in ONTa^{ONTb_1 \times ONTb_2 \times \ldots \times ONTb_k} = ONTa/b_1b_2...b_k,$$
$$\text{and for any } x_1, x_2, ..., x_k \in Var \text{ and for any } sf = a(x_1, x_2, ..., x_k) \in S_k$$
$$d(a(x_1, x_2, ..., x_k)) = \{(u_1, u_2, ..., u_k) \in U^k | d(a(x_1/u_1, x_2/u_2, ..., x_k/u_k)) = 1\}.$$

Quantifiers $\forall^k$ and $\exists^k$ are treated as functor-functions: $Var \times S_k \to S_{k-1}$ ($S_0 = S$). Thus,

$$\forall^k, \exists^k \in CATs_{k-1}/n_1s_k \qquad (s_0 = s).$$

Denotation for the quantifier $\forall^k$ is defined by induction as follows: for $k = 1$

$$d(\forall^1 xa(x)) = d(\forall^1)(d(x)), d(a(x))) = \begin{cases} 1 & \text{if} \quad d(x) = U = d(a(x)) \\ 0 & \text{if} \quad d(x) = U \neq d(a(x)); \end{cases}$$

and for $k = j + 1$ ($j > 0$)

$$d(\forall^{j+1} xa(x_1, x_2, ..., x, ..., x_{j+1})) = d(\forall^{j+1})(d(x), d(a(x_1, x_2, ..., x, ..., x_{j+1})) =$$
$$= \left\{(u_1, u_2, ..., u_{j+1}) \in U^j | d(a(x_1/u_1, x_2/u_2, ..., x/u, ..., x_{j+1}/u_{j+1})) = 1 \text{ for each } u \in U\right\}.$$

Thus, $d(\forall^k) \in ONTs_{k-1}/n_1s_k = ONTs_{k-1}^{ONTn_1 \times ONTs_k}$. Similarly so for $d(\exists^k)$.

Moreover, the principle (CA) is also valid for $\forall^k$ and $\exists^k$ in situational semantics.

▸ GIULIA BATTILOTTI, *Quantum states by first order variables: some consequences*.
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We discuss some points from the analysis of a predicative model of quantum states by sequents [2, 3]. The model introduces logical constants from equations between assertions, considering basic assertions from quantum mechanics. This provides a new interpretation of logical constants, in physical terms. In particular, the universal quantifier describes pure quantum states, the linear falsum and linear negation are discussed in terms of the spin observables and the related quantum uncertainty. Moreover, one could model quantum entanglement, overcoming the usual multiplicative parallelism, by adopting an infinitary view of first order domains and then extending the quantifiers to a symmetric predicative link.

The model helps to rethink the standard notions of first order variable, term and first order quantifier, fixed by the analytic tradition, before the birth of quantum physics (for the necessity to rethink the analytic tradition in the logical formalization, we quote e.g. Girard's work and [1]), and allows to read a deep relation between logical incompleteness and physical incompleteness. For, in the model, mixed states, rather than pure quantum states, can be obtained by "omega-rules" rather than by standard first order rules. Equivalently, characterizing a term, as a closed term or as a variable, is sensitive to the the gap induced by quantum measurement, that can be read as the gap between the meta-level and the object level. In particular, a closed term could be interpreted as a random variable at the metalevel. A further consequence is the validity of Gentzen's structural rules in relation with the existence and choice of such a gap. In particular structural rules can be introduced by means of variables, rather than by modalities, as in the approach of linear logic.

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[2] G. Battilotti, *Characterization of quantum states in predicative logic*, ***International Journal of Theoretical Physics***, vol. 50 (2011), pp. 3669–3681.

[3] G. Battilotti, *Quantum states as virtual singletons: converting duality into symmetry*, ***International Journal of Theoretical Physics***, vol. 53 (2014), pp. 3488–3502.

CONTRIBUTED TALKS 5

Tuesday, 4 August • 4.00PM–6.00PM
Venue - P617

▸ SREĆKO KOVAČ, *A formalization of Gödelian causal theory*.
Institute of Philosophy, a public research institute of the Republic of Croatia, Ul. grada Vukovara 54, 10000 Zagreb, Croatia.
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The idea of a Gödelian axiomatized theory of causality is a natural consequence of Gödel's programme of a transformation of philosophy into an axiomatized theory, and of his statements about causality as "the fundamental concept of philosophy" (Wang 1996, Gödel 1995 [*Coll. Works* 3]). We bring together Gödel's ontological system GO (1970, devised for a construction of an ontological argument) and his sketch of justification logic (*Lecture at Zilsel's*, 1938), and define an axiomatized causal ontology (QCGO) with causal terms replacing modalities.

Formally, QCGO is a second-order modification and extension of a justification logic with an S5-like propositional base. It includes definite descriptions and Gödelian ontological "positivity" axioms. Causal prefixes are first-order terms (causal variables are quantifiable), and are closed under special functional operations (extending the list of justification term operations of Gödel 1938, and Artemov and Yavorskaya 2011). We describe an appropriate semantics (modifying and extending Fitting semantics of first-order justification logic, Fitting 2014), and give the soundness and completeness proofs (a Gallin style construction of a consistent sequence of saturated sets of sentences is used). The ontological argument of GO is "realizable" within QCGO. Several other interesting propositions and theorems are proved, for example a causal counterpart of Gödel's "slingshot" proposition (Gödel 1944).

▸ JULIA JANKOWSKA, *Department of Philosophy, University of Warsaw, Krakowskie Przedmieście 3, 00-047 Warsaw, Poland*.
Gödel's philosophy of mathematics and structural realism about empirical sciences.
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The philosophy of abstract concepts to be found in the writings of Gödel may be combined with structural realism in the philosophy of empirical sciences.

On the one hand, the philosophy of mathematics that transpires from Gödel's papers can be interpreted as a kind of structural realism itself. On the other hand, structural realism in mathematics can be complemented by structural realism about empirical sciences as proposed by Ladyman and Ross [1], to jointly form a full and sufficient metaphysics. The main reason for combining Gödel with Ladyman and Ross is that despite the crucial role of mathematics in the empirical sciences, their book lacks an account of it. I will apply the structural realism of Ladyman and Ross to a new domain, mathematics, thus offering a clear position that is similar, and could be ascribed, to Gödel.

In my presentation, I will provide a summary of my interpretation of Gödel's views, which is alternative to Tieszen's monograph [2] and more general than the partial accounts to be found in many articles on Gödel. I will immerse it in one of the most convincing contemporary accounts of metaphysics and, at the same time, of the development of science. This interpretation is meant to go against some misunderstandings in the literature of the subject which, according to me, are mainly a result of a simplifying view of a triple division of solutions to the problem of universals and its analogy in the philosophy of mathematics.

[1] James Ladyman, Don Ross, with David Spurrett and John Collier, ***Every Thing Must Go: Metaphysics Naturalized***, Oxford University Press, 2007.
[2] Richard Tieszen, ***After Gödel***, Oxford University Press, 2011.

Axiomatization of Renaissance Geometry
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Modern axiomatics, as we know it today, was developed by David Hilbert. The first edition of the *Grundlagen der Geometrie* provided an axiomatization of Euclidean geometry. He built up Euclidean geometry from the undefined concepts *point, line* and *plane* and from a few undefined relations between them. The properties of the undefined concepts and relations are specified by the axioms as expressing certain related facts fundamental to our intuition. Thus we have informal axiomatizations by Pasch , Peano , and that Hilbert in the late nineteenth century, and Tarskis formal axiomatization in the twentieth. Proofs in these axiomatic systems, however, do not look much like proofs in the Elements. For example, does not take into account the importance of diagrams used in a Euclidean proof. So we need system in which diagrams are introduced in the course of a proof and serve to license inferences. One of the possible solutions is using diagams as objects represented by geometric objects on a finite coordinate grid. Another solution is to use natural deduction.

The purpose of the study is to describe Renaissance geometry represented by treatises of Piero della Francesca and Luca Pacioli. In their treatises one can find the advanced geometrical exercises presented in the form of propositions and they refer directly or indirectly to Euclidean geometry.

▸ JOSE ROQUETTE, *A Generalization of the Cantor-Dedekind Continuum*.
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We shall present a generalization of the Cantor-Dedekind continuum with explicit infinitesimals. Such infinitesimals obey the same basic rules as the other elements of the generalized continuum, in harmony with Leibniz's thought, except for one major difference: their product is null, as the Dutch theologian Bernard Nieuwentijt sustained. First, we introduce the concept of shadow, and then we define indiscernibility (the central concept), and monad. Monads of points are infinite-dimensional real affine spaces with the same cardinality as the whole generalized continuum, but they are also closed intervals with length 0; so they have a global-local nature. Monads and shadows, extended to any subset of the new continuum, possess interesting set-theoretic and topological properties of preservation. We work in two modes (sometimes, simultaneously, as in the concept of differentiability): potentiality (in the Cantor-Dedekind continuum), and actuality (in the generalized continuum, using such concepts as infinitesimal, indiscernibility, shadow, and monad). Although we do not introduce any definition of limit in the new continuum, we obtain the basic results of the differential calculus (the algebraic rules of derivation, the Chain Rule, the Inverse Function Theorem, the Mean Value Theorem, Taylor's Theorem,...), and present, as an application of the global-local nature of monads of points, two examples of differential treatment of singularities.

▸ JOAN BERTRAN-SAN MILLÁN, Lingua characterica *and* calculus ratiocinator*: the polemic between Frege and Schröder*.

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After the publication of *Begriffsschrift* in 1879, G. Frege and E. Schröder started a confrontation on their respective formal systems which had the traditional notions of *lingua characterica* and *calculus ratiocinator* as a background. Traditionally, the use of logic as a *lingua* has been tied to Frege, while the use of logic as *calculus* has been linked to the algebraic tradition—and, in particular, to Schröder. Jan van Heijenoort pointed at the elements that allow to draw this connection, but he did not properly explain why there should be such an association. In fact, both Frege and Schröder claimed that their own formal system was a better realisation of Leibniz's ideal language and considered the rival system as a mere *calculus ratiocinator*.

I will put forward a fresh reconstruction of the origin and motivation of this dispute. Most of the papers devoted to this issue merely mention some common places and relate this polemic to Leibniz (the common precedent), but they do not clarify either the dispute or the divergence on the conception of logic that allows to explain it. I will discuss how the divergent understanding of the Leibnizian notion of *lingua characterica* substantively reflects a fundamental difference in Frege's and Schröder conceptions on logic and its function as discipline. To shed light on these authors' account of this ideal language will be shown to be indispensable, even thought this task has been seldom addressed.

▸ GÜNTHER EDER, *Axiomatic metatheory: A Fregean perspective on independence proofs*.

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David Hilbert's *The Foundations of Geometry* (1899) is considered a landmark in the history of modern logic and mathematics by philosophers, mathematicians and logicians alike. In his 'Festschrift', Hilbert presents consistency and independence proofs for various fragments of his axiomatization of Euclidean geometry and provides a number of methodological innovations that were formative for our current understanding of mathematical theories and the axiomatic method. In reaction to Hilbert, Gottlob Frege, in a series of articles dating from 1903 to 1906, presents a thorough critique of Hilbert's underlying methodology. In the final part of a paper from 1906 ([1]), Frege eventually develops his own proposal as to how independence must be proved. His suggestions are both radical and puzzling: Frege claims that a 'new science' has to be established in order to rigorously prove the independence of genuine axioms. Although some have discussed various aspects of this new science, no systematic account of Frege's ideas on the matter has been devised so far. The aim of the talk is to sketch out how this lacuna might be filled. More specifically, the aims are to clarify (1) Frege's motivation for introducing a new science in the first place, (2) what this new science is supposed to look like and how it relates to concepts and methods in (pre-)modern mathematical logic, and (3) how it lines up with Frege's overall philosophy, what his approach implies for various interpretations of his views on metatheory and what we can learn from his basic approach.

[1] Gottlob Frege, *Über die Grundlagen der Geometrie*, ***Jahresbericht der Deutschen Mathematiker-Vereinigung***, vol. 12 (1906), pp. 293–309, pp. 377–403, pp. 423–430.

CONTRIBUTED TALKS 6

Tuesday, 4 August • 4.00PM–6.00PM
Venue - P673

▸ ZUZANA HANIKOVÁ, *On language fragments of propositional fuzzy logics*.

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Fuzzy logics are currently viewed ([1]) as semilinear members of the family of substructural logics. In particular, we study extensions of the logic MTL ([4]) and their computational behaviour. Currently, little is known about decidability criteria for these logics. CoNP-completeness has been shown for some stronger logics in the class, which can be approached via their tangible semantics: for example, Łukasiewicz logic and its extensions ([8, 3]), Gödel logic and its extensions, product logic. We look at the implicational fragments of these logics (following [6, 7]) and show that these are also coNP-complete. We propose to study some of the weaker logics in order to learn more about how the complexity of these logics is determined by that of their implicational fragments. On the other hand, the equational theory of the monoidal ($*$-) fragment of the standard MV-algebra is decidable in polynomial time. It is known also that the equational theory of the $\{*, \vee\}$-fragment of any nontrivial MTL-algebra is coNP-hard ([2]). We also recall some reductions available due to Glivenko theorems (cf. [5]).

[1] Libor Běhounek, Petr Cintula, *Fuzzy Logics as the Logics of Chains*, ***Fuzzy Sets and Systems***, vol. 157 (2006), no. 5, pp. 604–610.

[2] P. A. Bloniarz, H. B. Hunt III, D. J. Rosenkrantz, *Algebraic Structures with Hard Equivalence and Minimization Problems*, ***Journal of the Association for Computing Machinery***, vol. 31 (1984), no. 4, pp. 879–904.

[3] Petr Cintula, Petr Hájek, *Complexity Issues in Axiomatic Extensions of Łukasiewicz Logic*, ***Journal of Logic and Computation***, vol. 19 (2009), no. 2, pp. 245–260.

[4] Francesc Esteva, Lluís Godo, *Monoidal T-Norm Based Logic: Towards a Logic for Left-Continuous T-Norms*, ***Fuzzy Sets and Systems***, vol. 124 (2001), no. 3, pp. 271–288.

[5] Nikolaos Galatos, Peter Jipsen, Tomasz Kowalski, Hiroakira Ono, ***Residuated Lattices: An Algebraic Glimpse at Substructural Logics***, Studies in Logic and the Foundations of Mathematics, Elsevier, 2007.

[6] Yuichi Komori, *Super-Łukasiewicz implicational logics*, ***Nagoya Mathematical Journal***, vol. 72 (1978), pp. 127–133.

[7] Satoshi Miura, Shûrô Nagata, *Certain method for generating a series of logics*, ***Nagoya Mathematical Journal***, vol. 31 (1968), pp. 125–129.

[8] Daniele Mundici, *Satisfiability in Many-Valued Sentential Logic is NP-Complete*, ***Theoretical Computer Science***, vol. 52 (1987), no. 1–2, pp. 145–153.

▸ MARTINA DAŇKOVÁ, *Basic set-theoretical notions over fuzzy partial logic*.

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A simple system of fuzzy partial propositional logic has recently been introduced in [1]. It represents undefined truth by adding an extra truth value to the algebraic structure of the underlying fuzzy logic (see, e.g., [2]), and includes a large set of definable connectives to handle undefinedness. This approach can be extended to predicate logic, where the resulting system additionally accommodates partial fuzzy predicates and several families of partial lattice quantifiers (e.g., ones that ignore undefined instances and ones that require all instances to be defined).

With the semantics of partial fuzzy predicate logic established, we can start investigating basic notions of fuzzy partial set theory. The richer set of connectives and quantifiers of fuzzy partial logic leads to multiple variants of set-theoretical notions. In this contribution we shall focus on the notions of inclusion, equality, Cartesian product, and various kinds of relational composition: we shall discuss their meaning and investigate their relationships, mutual definability and basic properties.

(Supported by the ERDF project CZ.1.05/1.1.00/02.0070 “CE IT4Innovations”.)

[1] Běhounek L., Novák V., *Towards Fuzzy Partial Logic*, to appear in ***Proceedings of IEEE International Symposium on Multiple-Valued Logic*** (Waterloo, Ontario, Canada), May 2015, 6 pp.

[2] Hájek P., ***Metamathematics of Fuzzy Logic***, Kluwer, Dordrecht, 1998.

▸ LIBOR BĚHOUNEK, *Towards fuzzy partial logic of the first and higher orders*.

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A uniform undefinedness-friendly extension of implicative [3] expansions of the fuzzy propositional logic MTL [2] has recently been introduced [1]. By design, the extension is kept simple (undefinedness being represented by a single added truth value), but expressively rich—namely, containing many definable families of propositional connectives, corresponding to different ways of handling undefinedness; prominent among these are Bochvar-style connectives (for unrestricted propagation of undefinedness), Sobociński-style connectives (ignoring undefinedness as far as possible), Kleene-style connectives, etc. A Hilbert-style axiomatic system for this class of partial fuzzy propositional logics has been proposed and its completeness w.r.t. the intended algebraic semantics proved.

A natural next step is to extend these logics to the first and higher orders. In order to accommodate undefined values of terms (due, e.g., to non-terminating calculations, non-denoting iota-operators, or arguments outside the domains of functions), these extensions have to include extra constants to represent undefined results of each type. This contribution will discuss the semantics of quantifiers in first-order extensions of fuzzy partial propositional logics (esp. those generalizing Bochvar- and Sobociński-style lattice conjunctions and disjunctions), their interdefinability, and the semantics of the resulting fuzzy partial first- and higher-order logics.

(Supported by ERDF CZ.1.05/1.1.00/02.0070 and CZ.1.07/2.3.00/30.0010.)

[1] Běhounek L., Novák V., *Towards fuzzy partial logic*, to appear in ***Proceedings of IEEE International Symposium on Multiple-Valued Logic*** (Waterloo, Ontario), May 2015, 6 pp.

[2] Cintula P., Hájek P., Noguera C., editors. ***Handbook of Mathematical Fuzzy Logic***, College Publications, London, 2011.

[3] Rasiowa H., ***An Algebraic Approach to Non-Classical Logics***, North-Holland, 1974.

▸ ANDREI SIPOŞ, *Codensity and Stone spaces*.

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Codensity monads are a standard construction in category theory and/or functional programming that has been used to reduce the asymptotic performance of functional code [2], but also to provide a natural description of concepts like ultrafilters or ultraproducts [1]. More precisely, a functor between two categories with some weak conditions imposed upon them yields a canonical monad on the target category (and in the case that the functor is a right adjoint, the monad will be the monad corresponding to the adjunction). We can obtain some known non-trivial mathematical constructions by inputting standard functors into this machinery, thereby giving them a more natural motivation.This talk has as its goal to lay bare similar “inevitability” results for Stone spaces and sober spaces. The category of Stone spaces will be characterized as the essential image of the codensity monad of the inclusion of the category of finite sets into the category of topological spaces. To obtain sober spaces, the category of finite sets will be replaces by another category for which we will provide the motivation.

[1] Tom Leinster, *Codensity and the ultrafilter monad*, ***Theory and Applications of Categories***, vol. 28 (2013), pp. 332–370.

[2] Janis Voigtlnder, *Asymptotic Improvement of Computations over Free Monads*, ***9th International Conference on Mathematics of Program Construction***, Marseille, France, Philippe Audebaud and Christine Paulin-Mohring, editors, vol. 5133 of LNCS, Springer, 2008, pp. 388–403.

▸ PETR CINTULA, CARLES NOGUERA, *Completeness theorem for first-order algebraizable logics*.

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We generalize Henkin's proof [2] of completeness of classical first-order logic to the class of algebraizable logics introduced by Blok and Pigozzi [3]. Given a propositional logic L with an equivalent algebraic semantics $\mathbb{L}$ we can axiomatize the first order logic complete with respect to all models over algebras from $\mathbb{L}$ (e.g. all Boolean algebras in the case of classical logic). Furthermore, if L possesses a suitable disjunction connective we can axiomatize the first-order logic complete with respect to all models over relatively finitely subdirectly irreducible algebras from $\mathbb{L}$ (e.g. the two-valued Boolean algebra in the case of classical logic). The second result is obtained by non-trivial modifications of the original Henkin's proof by making use of the aforementioned disjunction connective. Our general framework covers previous approaches by Hájek, Horn, Rasiowa, Sikorski, and others and illuminates the ‘essentially first-order’ steps in the classical Henkin's proof. (This presentation is based on a recent paper [1].)

[1] Petr Cintula and Carles Noguera, *A Henkin-style proof of completeness for first-order algebraizable logics*, ***The Journal of Symbolic Logic***, vol. 80 (2015), no. 1, pp. 341–358.

[2] Leon Henkin, *The completeness of the first-order functional calculus*, ***The Journal of Symbolic Logic***, vol. 14 (1949), no. 3, pp. 159–166.

[3] Willem J. Blok and Don L. Pigozzi, ***Algebraizable logics***, Memoirs of the American Mathematical Society, vol. 396, American Mathematical Society, Providence, RI 1989.

▸ MOHAMED KHALED, *Gödel's incompleteness property for a decidable fragment of arrow logic.*
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The class of weak associative relation algebras WA was introduced by Maddux, who showed that this class is representable. Nemeti showed that the equational theory of this class is decidable. It was posed as an open question, by Nemeti 1985, whether the finitely generated free algebras of the class WA are atomic or not. Atomicity of algebras of logic are connected to Gödel's incompleteness property. In this talk, we show that, $\mathfrak{Fr}_m WA$ is not atomic for every finite $m \geq 1$ and that $\mathfrak{Fr}_0 WA$ is finite, hence atomic.

CONTRIBUTED TALKS 7

Tuesday, 4 August • 4.00PM–6.00PM

Venue - P674

▸ LAURI HELLA, JOHANNA STUMPF, *The expressive power of modal inclusion logic.*
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Modal inclusion logic is a variant of *modal dependence logic*, $\mathcal{MDL}$, which was introduced by Jouko Väänänen [1]. The idea of $\mathcal{MDL}$ is to extend usual modal logic by atoms that express functional dependences between propositional variables. The intended meaning of such a dependence atom $=(p_1, \ldots, p_n, q)$ is that the truth value of q is determined by the truth values of $p_1, \ldots, p_n$. However, this is trivially true if we consider the truth of propositions in a single world of a Kripke model. For this reason the semantics of $\mathcal{MDL}$ is defined on *teams*, i.e., sets of worlds, instead of single worlds.

In [2] the authors introduced *extended modal dependence logic*, $\mathcal{EMDL}$, that is obtained by allowing dependence atoms $=(\varphi_1, \ldots, \varphi_n, \psi)$, where $\varphi_1, \ldots, \varphi_n, \psi$ are arbitrary formulas of modal logic. The expressive power of $\mathcal{EMDL}$ was studied extensively in [3], where it was proved that a class C of Kripke models with teams is definable in $\mathcal{EMDL}$ if and only if C is downwards closed, and closed under team k-bisimulation for some k. Furthermore, $\mathcal{EMDL}$ was shown to have the same expressive power as $\mathcal{ML}(\sqcup)$, the extension of modal logic with intuitionistic disjunction. On the other hand, it was proved in [3] that $\mathcal{EMDL}$ is exponentially more succinct than $\mathcal{ML}(\sqcup)$: any translation of $=(p_1, \ldots, p_n, q)$ to an $\mathcal{ML}(\sqcup)$-formula has length at least 2^n.

Modal inclusion logic, $\mathcal{MINC}$, is the extension of modal logic with inclusion atoms $\varphi_1 \ldots \varphi_n \subseteq \psi_1 \ldots \psi_n$. This atom is true in a team T if for every world $u \in T$ there is a world $v \in T$ such that $\psi_1 \ldots \psi_n$ gets the same truth values in v as $\varphi_1 \ldots \varphi_n$ gets in u. In this talk, we consider the expressive power of $\mathcal{MINC}$, and prove results that are surprisingly similar to the ones given in [3]. First we show that a class C of Kripke models with teams is definable in $\mathcal{MINC}$ if and only if C is closed under unions and under team k-bisimulation for some k. Then we show that $\mathcal{MINC}$ has the same expressive power as the extension $\mathcal{ML}(\nabla)$ of modal logic with a unary non-emptiness connective ∇. Finally, we prove that $\mathcal{MINC}$ is exponentially more succinct than $\mathcal{ML}(\nabla)$ by showing that any translation of $p_1 \ldots p_n \subseteq q_1 \ldots q_n$ to an $\mathcal{ML}(\nabla)$-formula has length at least 2^n.

[1] Väänänen, J., *Modal dependence logic*, ***New Perspectives on Games and Interaction*** (K. R. Apt and R. van Rooij, editors), Texts in Logic and Games 4, 2008, pp. 237–254.

[2] Ebbing, J., L. Hella, A. Meier, J.-S. Müller, J. Virtema and H. Vollmer, *Extended modal dependence logic*, ***WoLLIC***, 2013, pp. 126–137.

[3] Hella L., K. Luosto, K. Sano and J. Virtema, *The Expressive Power of Modal Dependence Logic*, ***AiML***, 2014, pp. 294-312.

▸ KERKKO LUOSTO, *Dimension theory for modal logics.*
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The expressive power of various modal logics with team semantics is studied. This means that, contrary to the ordinary pointed semantics on Kripke structures, the satisfaction is defined not for mere points (worlds), but for teams, i.e, subsets of the domain of the Kripke structure. This results in certain finesses as to how to handle the propositional connectives, e.g., for classical disjunction we define

$$K, T \models \varphi \vee \psi \quad \Leftrightarrow \quad K, T_1 \models \varphi \text{ and } K, T_2 \models \psi \text{ for some } T_1, T_2 \text{ such that } T_1 \cup T_2 = T,$$

but for the intuitionistic disjunction we have

$$K, T \models \varphi \otimes \psi \quad \Leftrightarrow \quad K, T \models \varphi \text{ or } K, T \models \psi,$$

where K is a Kripke structure and T is a team. Adding the intuitionistic disjunction to the basic modal locic ML we get ML($\otimes$), which is equivalent to *extended modal dependence logic* EMDL. The latter is the extension of ML by the *dependence atoms* $\mathrm{dep}(\psi_1, \ldots, \psi_n, \theta)$ with semantics

$$K, T \models \mathrm{dep}(\psi_1, \ldots, \psi_n, \theta)$$
$$\Longleftrightarrow \forall w, v \in T : \bigwedge_{i=1}^{n} (K, \{w\} \models \psi_i \Leftrightarrow K, \{v\} \models \psi_i) \text{ implies } (K, \{w\} \models \theta \Leftrightarrow K, \{v\} \models \theta).$$

I shall demonstrate the tools that are used to study the expressive power of EMDL. In particular, I shall develop some dimension theory for modal logics to this end. This is joint work with Lauri Hella, Katsuhiko Sano and Jonni Virtema [1]. I present some examples which could not be included in that paper.

[1] Lauri Hella, Kerkko Luosto, Katsuhiko Sano, and Jonni Virtema. *The expressive power of modal dependence logic.* ***Advances in Modal Logic*** Groningen, The Netherlands, August 5-8, 2014, Rajeev Goré, Barteld P. Kooi, and Agi Kurucz, editors, vol. 10, pp. 294–312. College Publications, 2014.

▸ FREDRIK ENGSTRÖM, *A maximal semantics for dependence logic.*
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Dependence logic, proposed by Väänänen [2], is an elegant way of introducing dependencies between variables into the object language. The framework of dependence logic, so-called team semantics, has turned out to be very flexible and allows for interesting generalizations. Instead of considering satisfaction with respect to a single assignment s, team semantics considers sets of assignments X, called teams.

The semantics of Dependence logic is based on the principle that

> a formula φ is satisfied by a team X if for every assignment $s : \mathrm{dom}(X) \to M^k$, if $s \in X$ then s satisfies φ.

The compositional semantics of dependence logic, except for the case for the dependence atom, can be derived from this one principle.

In this paper we introduce a new semantics, which is better suited for generalized quantifiers, where the above is replaced by the principle that

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a formula φ is satisfied by a team X if for every assignment $s : \mathrm{dom}(X) \to M^k$, $s \in X$ iff s satisfies φ,

replacing an implication by an equivalence. When only first-order logic is considered in this new setting nothing exciting happens. It is only when we introduce atoms, like dependence atoms, or new logical operations that things start to get more exciting.

This alternative semantics will allow us to extend the logic with any generalized quantifier, not only monotone increasing ones as in [1].

[1] FREDRIK ENGSTRÖM, *Generalized quantifiers in Dependence logic*, ***Journal of Logic, Language and Information***, vol. 21 (2012), pp. 299–324.

[2] JOUKO VÄÄNÄNEN, ***Dependence logic. A new approach to independence friendly logic***, London Mathematical Society Student Texts, Cambridge University Press, 2007.

▶ RAINE RÖNNHOLM, *Defining properties of teams in k-ary inclusion-exclusion logic*.
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The k-ary inclusion-exclusion logic, INEX[k], is obtained by extending first order logic with k-ary inclusion and exclusion atoms. The semantics for this logic is defined by using sets of assignments, called teams, that can naturally be interpreted as databases. The truth conditions for inclusion and exclusion atoms correspond to inclusion and exclusion dependencies in the database theory.

We will examine the expressive power of INEX[k] on the level of formulas, by analyzing what kind properties of teams can be defined with it. By earlier results, INEX[k] is closely related k-ary existential second order logic, ESO[k]. We know that all ESO[k]-definable properties of k-ary relations of teams can be defined in INEX[k] and that all INEX[k]-definable properties are ESO[k]-definable.

However, when the arity of relations becomes higher than the arity of atoms, things get more exotic. We will show that for any k there are some very simple FO-definable properties of (k+1)-ary relations that cannot be defined in INEX[k]. For example, by using unary inclusion and exclusion atoms, we cannot define the symmetry of a binary relation. But interestingly in INEX[1] we can define many properties of binary relations that are not FO-definable, such as disconnectivity of a graph.

To prove our undefinability results we will introduce a new method: Suppose that φ is a INEX[k]-formula and X is a team. Suppose also that φ is true in X, i.e. verifier has a winning strategy in the corresponding semantic game. We will then consider the reducts of this strategy for semantic games of subteams $Y \subseteq X$. We can show that if X is large enough compared to the size of φ, then the reduct strategy corresponding the team $X \setminus \{s\}$ is a winning strategy for any assignment $s \in X$.

▶ ROSALIE IEMHOFF, FAN YANG, *Some proof theoretical results on propositional logics of dependence*.
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Dependence logic is a new logical formalism that characterizes the notion of "dependence" in social and natural sciences. First-order dependence logic was introduced by Väänänen [7] as a development of *Henkin quantifier* [2] and *independence-friendly logic* [3]. Recently, propositional dependence logic (PD) was studied and axiomatized in [8][6]. Dependency relations are characterized in PD by a new type of atoms $=(\vec{p}, q)$, called *dependence atoms*. Intuitively, the atom specifies that *the proposition q depends completely on the propositions $\vec{p}$*. The semantics of PD is called *team semantics*, introduced by Hodges [4][5]. The basic idea of this new semantics is that properties of dependence cannot be manifested in *single* valuations, therefore unlike the case of classical propositional logic, formulas of PD are evaluated on *sets* of valuations (called *teams*) instead.

In this talk, we present some proof theoretical results on PD and its variants, including intuitionistic dependence logic (PID), which was noted in [9] to be equivalent to propositional inquisitive logic [1]. Based on the deductive systems of these logics which was developed in [8], we prove the Craig's interpolation theorem for PD, PID and their variants. We also prove that all these logics of dependence are structurally complete with respect to a class of substitutions under which the logics are closed, that is, all admissible rules of these logics are derivable in their deductive systems.

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[1] I. CIARDELLI AND F. ROELOFSEN, *Inquisitive Logic*, ***Journal of Philosophical Logic***, vol. 40, no. 1, pp. 55-94, 2011.

[2] L. HENKIN, *Some remarks on infinitely long formulas*, ***Infinitistic Methods***, Proceedings Symposium Foundations of Mathematics, pp 167-183, 1961

[3] J. HINTIKKA AND G. SANDU, *Informational Independence as a Semantical Phenomenon*, ***Logic, Methodology and Philosophy of Science***, Amsterdam: Elsevier, pp. 571-589, 1989

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[6] K. SANO AND J. VIRTEMA, *Axiomatizing Propositional Dependence Logics*, ***to appear***.

[7] J. VÄÄNÄNEN, ***Dependence Logic: A New Approach to Independence Friendly Logic***, Cambridge: Cambridge University Press, 2007.

[8] F. YANG AND J. VÄÄNÄNEN, *Propositional Logics of Dependence and Independence, Part I*, ***submitted***, preprint available at: http://arxiv.org/abs/1412.7998.

[9] F. YANG, *On Extensions and Variants of Dependence Logic*, ***University of Helsinki***, 2014.

▶ JONNI VIRTEMA, *Definability in modal logics with team semantics*.
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The entrenched practice in defining semantics for logics has been the use of singletons as the satisfying elements of formulae (e.g., assignments in first-order logic and domain points in modal logics). However in many applications it is vital to study properties of collections of things. In *team semantics* the idea is to shift from *singletons* to *sets* (i.e., *teams*) as satisfying elements of formulae. In the *team semantics* of first-order logic (modal logic) formulae are evaluated with respect to first-order structures (Kripke structures) and sets of assignments (sets of worlds). Team semantics was introduced to the framework of first-order logic (modal logic) by Hodges (by Väänänen) in the late 90s (early 2000). In this abstract, we survey the state-of-the-art related to definability in team-based modal logics.

By a famous result of Gabbay and van Benthem, a class of pointed Kripke structures is definable by a formula of modal logic iff the class is closed under k-bisimulation. The celebrated Goldblatt–Thomason theorem is a characterization of modal definability of elementary (i.e., first-order definable) classes of Kripke frames by four frame constructions. Inspired by the former result, Hella et al. (AiML 2014) established that exactly the properties of teams that are *downward closed* and closed under the so-called *team k-bisimulation* are definable in *extended modal dependence logic*. Inspired by the result of Goldblatt and Thomason, Sano and Virtema (WoLLIC 2015, to appear) gave Goldblatt–Thomason -style theorems for modal dependence logics. They showed that an elementary class of Kripke frames is definable in (extended) modal dependence logic iff the class is closed under taking generated subframes and bounded morphic images, and reflects ultrafilter extensions and finitely generated subframes.

CONTRIBUTED TALKS 8

Tuesday, 4 August • 4.00PM–6.00PM
Venue - P722

▸ RUSSELL MILLER, *Degree spectra of real closed fields.*
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We discuss the possible Turing degree spectra of real closed fields, and develop a Turing-computable embedding of graphs into real closed fields. From this embedding, we conclude that, for every countable, automorphically non-trivial structure $\mathcal{A}$, there exists a real closed field whose spectrum is precisely $\{\boldsymbol{d} : \boldsymbol{d}' \in \mathrm{Spec}(\mathcal{A})\}$, the pre-image of the spectrum of $\mathcal{A}$ under the jump operation.

This is joint work with Victor Ocasio Gonzalez.

▸ NIKOLAY BAZHENOV, MARGARITA MARCHUK, *Degrees of autostability for prime Boolean algebras.*
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Let $\mathbf{d}$ be a Turing degree. A computable structure $\mathfrak{A}$ is $\mathbf{d}$-*autostable* if, for every computable structure $\mathfrak{B}$ isomorphic to $\mathfrak{A}$, there exists a $\mathbf{d}$-computable isomorphism from $\mathfrak{A}$ onto $\mathfrak{B}$. Let $\mathfrak{A}$ be a computable structure. A Turing degree $\mathbf{d}$ is called the *degree of autostability* of $\mathfrak{A}$ if $\mathbf{d}$ is the least degree such that $\mathfrak{A}$ is $\mathbf{d}$-austostable. Note that here we follow [1] and use the term *degree of autostability* in place of *degree of categoricity.*

Let B be a Boolean algebra. The *invariant* of B is the triple $\mathtt{ch}(B) = (ch_1(B), ch_2(B), ch_3(B))$ (see [2] for more detailed definitions). Let $\mathtt{Pr}(p,q,r)$ denote the Boolean algebra B such that $\mathtt{ch}(B) = (p,q,r)$ and B is a prime model for the theory $\mathtt{Th}(B)$. We say that $\mathtt{Pr}(p,q,r)$ is a *prime Boolean algebra* for the invariant (p,q,r). Using results from [3] we obtain the following theorem

Theorem 1. *Suppose that* $0 \le p, q < \omega$.
(1) $\mathbf{0}^{(3p+1)}$ *is the degree of autostability for the algebras* $\mathtt{Pr}(p,\infty,0)$ *and* $\mathtt{Pr}(p,\infty,1)$.
(2) $\mathbf{0}^{(3p+2)}$ *is the degree of autostability for* $\mathtt{Pr}(p+1,q+1,0)$.
(3) $\mathbf{0}^{(3p+3)}$ *is the degree of autostability for* $\mathtt{Pr}(p+1,q,1)$.
(4) $\mathbf{0}^{(\omega)}$ *is the degree of autostability for* $\mathtt{Pr}(\infty,0,0)$.

Corollary 2. *Suppose that* $0 \le \alpha \le \beta \le \omega$. *There exists a decidable structure* $\mathfrak{M}$ *such that* $\mathbf{0}^{(\alpha)}$ *is the degree of autostability relative to strong constructivizations of* $\mathfrak{M}$ *and* $\mathbf{0}^{(\beta)}$ *is the degree of autostability of* $\mathfrak{M}$.

This work was supported by RFBR (grant 14-01-00376), and by the Grants Council (under RF President) for State Aid of Leading Scientific Schools (grant NSh-860.2014.1).

[1] S. S. Goncharov, *Degrees of Austostability Relative to Strong Constructivizations*, ***Proceedings of the Steklov Institute of Mathematics***, vol. 274 (2011), no. 1, pp. 105–115.

[2] S. S. Goncharov, ***Countable Boolean Algebras and Decidability*** , Siberian School of Algebra and Logic, Springer Science & Business Media, 1997.

[3] J. Mead, *Recursive prime models for Boolean algebras*, ***Colloquium Mathematicum***, vol. 41 (1979), pp. 25–33.

▸ ANDREY FROLOV, *Effective categoricity on computable linear orderings.*
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First, I will talk about degrees of categoricity on computable linear orderings. The degree of categoricity of a computable structure (in particular, a linear ordering) is the least degree d such that the structure is d-computably categorical.

I will show that for any d-c.e. degree above and in $0''$ is the degree of categoricity of some computable linear ordering.

The main result of my talk is to construct $0''$-computably categorical linear ordering which is not relative $0''$-computably categorical.

▸ NURLAN KOGABAEV, *The theory of projective planes is complete with respect to degree spectra and effective dimensions.*
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Hirschfeldt, Khoussainov, Shore, and Slinko [1] proved that the theory of directed graphs is complete in the following computable-model-theoretic sense: for every countable structure $\mathcal{A}$, there exists a countable directed graph $\mathcal{G}$ which has the same degree spectrum as $\mathcal{A}$, the same $\mathbf{d}$-computable dimension as $\mathcal{A}$ (for each degree $\mathbf{d}$), the same computable dimension as $\mathcal{A}$ under expansion by a constant, and which realizes every degree spectrum $\mathrm{DgSp}_{\mathcal{A}}(R)$ (for every relation R on $\mathcal{A}$) as the degree spectrum of some relation on $\mathcal{G}$.

Moreover, in [1] the authors proved that the properties mentioned above hold not only of directed graphs, but also of symmetric irreflexive graphs, partial orderings, lattices, rings, integral domains of arbitrary characteristic, commutative semigroups, and 2-step nilpotent groups.

Miller, Park, Poonen, Schoutens, and Shlapentokh [2] presented an effective coding of graphs into countable fields and proved that the theory of fields is complete with respect to degree spectra of nontrivial structures, $\mathbf{d}$-computable dimensions, degree spectra of relations, categoricity spectra, and automorphism spectra.

In the present paper we show that some natural coding of fields into pappian projective planes preserves most computable-model-theoretic properties and obtain the following result.

Theorem. *The theory of pappian projective planes is complete with respect to degree spectra of nontrivial structures,* $\mathbf{d}$*-computable dimensions, degree spectra of relations, categoricity spectra, and automorphism spectra.*

In particular, for every natural $n \geqslant 2$ *there exists a pappian projective plane with computable dimension* n.

This work was supported by RFBR (grants 14-01-00376-a, 13-01-91001-FWF-a) and by the Grants Council under RF President for State Aid of Leading Scientific Schools (grant NSh-860.2014.1).

[1] D.R.Hirschfeldt, B.Khoussainov, R.A.Shore, A.M.Slinko, *Degree spectra and computable dimensions in algebraic structures*, ***Annals of Pure and Applied Logic***, vol. 115 (2002), no. 1-3, pp. 71–113.

[2] R.Miller, J.Park, B.Poonen, H.Schoutens, A.Shlapentokh, *Coding graphs into fields*, ***Logic Colloquium 2014, Abstract Booklet*** (Vienna, 14-19 July 2014), p. 80.

▸ RAVIL BIKMUKHAMETOV, *Computable linear orders with some natural relations*.
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The first goal of the research is to study an algorithmic dependence of several natural relations on computable presentations of the linear orders, namely the successor, the block, the density, the right and the left limit relations (see [1] for details). These relations independently appear in various studies and play an important role in studying and classification of linear orders. M. Moses [2] showed that if a linear order has a computable presentation with the computable block relation then it has a computable presentation with the computable successor relation. We show that there are no other dependencies between considered relations except the one which obtained by M. Moses [3].

Another area of study is initial segments of computable linear orders with additional computable natural relations. M. Raw [4] showed that any Π_1^0-initial segment of a computable linear order has a computable presentation. M. Zubkov [5] proved that the analogue of M. Raw's result is false in the case of initial segments with additional computable successor and block relations. We show that this is also holds in the case of the density, the right and the left limit relations [6].

[1] W.P. Turner, ***Computable linear orders and Turing reductions: Master's Thesis.***, University of Connecticut, 2012.

[2] M. Moses, ***Recursive Properties of Isomophism Types: Ph.D. Thesis***, Monash Univ., Clayton, Victoria, Australia, 1983.

[3] R.I. Bikmukhametov, *Codings on Linear Orders and Algorithmic Independence of Natural Relations*, ***Lobachevskii Journal of Mathematics***, vol. 35 (2014), no. 4, pp. 326–331.

[4] M.J.S. Raw, ***Complexity of automorphisms of recursive linear orders: Ph.D. Thesis***, University of Wisconsin-Madison, 1995.

[5] M.V. Zubkov, *Initial segments of computable linear orders with additional computable predicates*, ***Algebra and Logic***, vol. 48 (2009), no. 5, pp. 564–579.

[6] R.I. Bikmukhametov, *Initial segments of computable linear orders enriched by natural relations*, ***Izvestiya Vysshikh Uchebnykh Zavedenii. Matematika***, to appear.

CONTRIBUTED TALKS 9

Tuesday, 4 August • 4.00PM–6.00PM
Venue - P723

▸ MARGARITA MARCHUK, *Autostability relative to strong constructivizations of computable structures of nontrivial language*.
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For a class K of structures, closed under isomorphism, the index set is the set $I(K)$ of all indices for computable members of K in a universal computable numbering of all computable structures for a fixed computable language. We study the complexity of the index set of class of computable structures, which are autostable relative to strong constructivizations.

The model is called *autostable relative to strong constructivizations* if for any two strong constructivisations ν_1 and ν_2 of the model $\mathfrak{M}$ there exist automorphism α of the model $\mathfrak{M}$ and total recursive function f such that $\alpha\nu_1 = \nu_2 f$. A. T. Nurtazin has found criteria for autostability relative to strong constructivizations, see [1]. This criteria shows strong connection between the problem of autostability relative to strong constructivizations and the properties of model. On the base of the results of [2] we prove the following theorems.

Theorem 1. *Let L be a finite nontrivial language, i.e. containing a predicate symbol of arity ≥ 2 or functional symbol of arity ≥ 2 Then index set of all computable structures of this language, which are autostable relative to strong constructivization is m-complete $\Sigma_3^0(\emptyset^\omega)$;*

Theorem 2. *The index set of computable structures with two equivalence relations, which are autostable relative to strong constructivization is m-complete $\Sigma_3^0(\emptyset^\omega)$;*

Using the results of [3], we obtain the following theorem.

Theorem 3. *The isomorphism problem for a class of computable structures with two equivalence relations is m-complete Σ_1^1 set.*

This work was supported by RFBR (grant 14-01-00376).

[1] A. T. Nurtasin, *Strong and Weak Constructivization and Computable Families*, ***Algebra and Logic***, vol. 13 (1974), no. 3, pp. 177–184.

[2] S. S. Goncharov, M. I. Marchuk, *Index Sets of Constructive Models that are Autostable Under Strong Constructivizations*, ***Journal of Mathematical Sciences***, vol. 205 (2015), no. 3, pp. 368–388.

[3] S. S. Goncharov, J. F. Knight, *Computable Structure and Non-Structure Theorems*, ***Algebra and Logic***, vol. 41 (2002), no. 6, pp. 639–681.

▸ RASMUS BLANCK, *Flexible formulae and partial conservativity*.
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In [3], Woodin constructs an r.e. set W_e with the following feature: If $\mathcal{M}$ is any countable model of PA, and s is any $\mathcal{M}$-finite set such that $W_e^{\mathcal{M}} \subseteq s$, then there is an end-extension $\mathcal{N}$ of $\mathcal{M}$, such that $\mathcal{N} \models$ PA, and $W_e^{\mathcal{N}} = s$.

The set W_e has a distinct flavour of "flexibility" in the sense of e.g. Kripke [1] and Mostowski [2], who extend the first incompleteness theorem by constructing formulae whose "extensions as sets are left undetermined by the formal system". Moreover, Woodin implicitly establishes the Π_1-conservativity of $\mathrm{T} + W_e = s$ over $\mathrm{T} + W_e \subseteq s$, which by the Orey-Hájek-Guaspari-Lindström characterisation allows the removal of the countability restriction from Woodin's theorem.

In this talk, which reports on joint work with Ali Enayat, I give an overview of flexibility, and its relationship to Π_1-conservativity and interpretability. This includes some characterisations of Π_1-conservativity, and a discussion of how the relationship between these notions varies with the choice of base theory.

[1] Saul A. Kripke, *"Flexible" predicates of formal number theory*, ***Proceedings of the American Mathematical Society***, vol. 13 (1962), no. 4, pp. 647–650.

[2] A. Mostowski, *A generalization of the incompleteness theorem*, ***Fundamenta Mathematicae***, vol. 49 (1961), no. 2, pp. 205–232.

[3] W. Hugh Woodin, *A potential subtlety concerning the distinction between determinism and nondeterminism*, ***Infinity: New Research Frontiers*** (Michael Heller and W. Hugh Woodin, editors), Cambridge University Press, 2011, pp. 119–129.

▸ MARIJA BORIČIĆ, *Suppes–style rules for probability logic.*
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We propose an unexpectedly elegant system of probabilistic inference rules enabling to work with the expressions of the form $\Gamma \vdash^n \Delta$, a generalization of Gentzen's sequents $\Gamma \vdash \Delta$ (see [2]), meaning that 'the truthfulness probability of the sequent $\Gamma \vdash \Delta$ is greater than or equal to $1 - n\varepsilon$', for a given small real $\varepsilon > 0$ and any natural number n. For instance, the rules treating implication are as follows:

$$\frac{\Gamma \vdash^n A\Delta \quad \Pi B \vdash^m \Lambda}{\Gamma\Pi A \to B \vdash^{m+n} \Delta\Lambda}(\to\vdash) \qquad \frac{\Gamma A \vdash^n B\Delta}{\Gamma \vdash^n A \to B\Delta}(\vdash\to)$$

and the cut rule:

$$\frac{\Gamma \vdash^n A\Delta \quad \Pi A \vdash^m \Lambda}{\Gamma\Pi \vdash^{m+n} \Delta\Lambda}(\mathrm{cut})$$

These rules are based on Suppes' and Hailperin's ideas (see [3], [7], [8]). Our system, an extension of Gentzen's sequent calculus for classical propositional logic (see [2]), is sound and complete with respect to a kind of Carnap–Popper–Leblanc–type probability logic semantics (see [1], [4], [5], [6]).

[1] R. Carnap, ***Logical Foundations of Probability***, University of Chicago Press, Chicago, 1950.

[2] G. Gentzen, *Untersuchungen über das logische Schliessen*, ***Mathematische Zeitschrift***, vol. 39 (1934–35), pp. 176–210, 405–431, or G. Gentzen, ***Collected Papers***, (ed. M. E. Szabo), North–Holland, Amsterdam, 1969.

[3] T. Hailperin, *Probability logic*, ***Notre Dame Journal of Formal Logic***, vol. 25 (1984), pp. 198–212.

[4] H. Leblanc, B. C. van Fraassen, *On Carnap and Popper probability functions*, ***The Journal of Symbolic Logic***, vol. 44 (1979), pp. 369–373.

[5] H. Leblanc, *Probability functions and their assumption sets — the singulary case*, ***Journal of Philosophical Logic***, vol. 12 (1983), pp. 382–402.

[6] K. R. Popper, *Two autonomous axiom systems for the calculus of probabilities*, ***The British Journal for the Philosophy of Science***, vol. 6 (1955), pp. 51–57, 176, 351.

[7] P. Suppes, *Probabilistic inference and the concept of total evidence*, ***Aspects of Inductive Inference***, (J. Hintikka and P. Suppes, editors), North–Holland, Amsterdam, 1966, pp. 49–55.

[8] C. G. Wagner, *Modus tollens probabilized*, ***British Journal for the Philosophy of Science***, vol. 54(4) (2004), pp. 747-753.

▸ RUTGER KUYPER, *A hierarchy of uniformities between Medvedev and Muchnik reducibility.*
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Given two *mass problems*, i.e. subsets $\mathcal{A}, \mathcal{B} \subseteq \omega^\omega$, there are two well-known ways in computability theory to compare their computational content. Namely, we say that $\mathcal{A}$ *Medvedev reduces* to $\mathcal{B}$ if there is a uniform way of computing an element of $\mathcal{A}$ from each element of $\mathcal{B}$ (formally, if there is a Turing functional Γ such that $\Gamma(\mathcal{B}) \subseteq \mathcal{A}$), and we say that $\mathcal{A}$ *Muchnik reduces* to $\mathcal{B}$ if there is a non-uniform way of computing an element of $\mathcal{A}$ from each element of $\mathcal{B}$ (formally, if for every $f \in \mathcal{B}$ there is a Turing functional Γ_f such that $\Gamma_f(f) \in \mathcal{A}$).

If one only considers these two concepts, then if a given reduction is not uniform, one can only conclude that the reduction is 'just' a Muchnik reduction. However, often this conclusion is too crude and ignores the fact that the reduction has some uniform content; one subfield in which this is often true is in algorithmic randomness. To remedy this, we introduce a hierarchy of reductions between Medvedev and Muchnik reducibility, which we call the *(uniform) n-reducibilities.* Informally, a mass problem $\mathcal{A}$ uniformly n-reduces to a mass problem $\mathcal{B}$ if the elements of $\mathcal{B}$ compute elements of $\mathcal{A}$ "uniformly up to a Π^0_n-choice". This definition is inspired by the work of Higuchi and Kihara [1], who studied uniform 1-reducibility (under a different name).

In this talk we will introduce n-reducibility and study some of its basic properties.

[1] K. Higuchi and T. Kihara, *Inside the Muchnik degrees I: Discontinuity, learnability, and constructivism*, ***Annals of Pure and Applied Logic***, vol. 165 (2014), no. 5, pp. 1058–1114.

▸ RUPERT HÖLZL AND PAUL SHAFER, *Universality, optimality, and randomness deficiency.*
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A Martin-Löf test $\mathcal{U}$ is *universal* if it captures all non-Martin-Löf random sequences, and it is *optimal* if for every ML-test $\mathcal{V}$ there is a $c \in \omega$ such that $\forall n(\mathcal{V}_{n+c} \subseteq \mathcal{U}_n)$. We study the computational differences between universal and optimal ML-tests as well as the effects that these differences have on both the notion of layerwise computability (introduced by Hoyrup and Rojas [1]) and the Weihrauch degree of LAY (introduced by Brattka, Gherardi, and Hölzl [2]), which is the function that produces a bound for a given Martin-Löf random sequence's randomness deficiency. We prove several robustness and idempotence results concerning the Weihrauch degree of LAY, and we show that layerwise computability is more restrictive than Weihrauch reducibility to LAY.

[1] Mathieu Hoyrup and Cristóbal Rojas, *An application of Martin-Löf randomness to effective probability theory*, ***Mathematical Theory and Computational Practice: 5th Conference on Computability in Europe, CiE 2009*** (Heidelberg), (Klaus Ambos-Spies, Benedikt Löwe, and Wolfgang Merkle, editors), Springer-Verlag Berlin Heidelberg, 2009, pp. 260–269.

[2] Vasco Brattka, Guido Gherardi, and Rupert Hölzl, *Probabilistic Computability and Choice*, ***to appear in Information and Computation***.

▸ MATEUSZ ŁEŁYK, BARTOSZ WCISŁO, *On the Δ_0 induction for the compositional truth predicate.*
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Answering the question posed independently by Albert Visser and Richard Heck, we prove that the theory of compositional truth over arithmetical language with bounded induction is not conservative over Peano Arithmetic.

The theory CT^- (*compositional truth*) is obtained via expanding the language of PA

1. $\forall \ulcorner s \urcorner, \ulcorner t \urcorner \;\; T\ulcorner s = t \urcorner \equiv (s^\circ = t^\circ)$
2. $\forall \ulcorner \phi \urcorner, \ulcorner \psi \urcorner \;\; T\ulcorner \phi \odot \psi \urcorner \equiv (T\ulcorner \phi \urcorner \odot T\ulcorner \psi \urcorner)$
3. $\forall \ulcorner \phi \urcorner \;\; T\ulcorner Qx\ \phi(x) \urcorner \equiv (Qt\ T\ulcorner \phi(t) \urcorner)$
4. $\forall \ulcorner \phi \urcorner \;\; T\ulcorner \neg\phi \urcorner \equiv (\neg T\ulcorner \phi \urcorner)$,

where $\odot \in \{\wedge, \vee\}$, $Q \in \{\forall, \exists\}$ the variables ϕ, ψ quantifies over (Gödel codes of) arithmetical formulae, s, t quantifies over (codes of) arithmetical terms and $^\circ$ represents the valuation of terms.

It is a classical result in formal theories of truth (see [2]), that CT^- is conservative over Peano Arithmetic. On the other hand, if we extend CT^- with Σ_1-induction for the truth predicate, the resulting theory proves the following global reflection principle:

$$\forall \ulcorner \phi \urcorner \;\; \mathrm{Pr}(\ulcorner \phi \urcorner) \to T \ulcorner \phi \urcorner.$$

Here Pr is the standard provability predicate for the Peano Arithmetic. In particular, that theory is not conservative over PA. We show that CT^- with Δ_0- induction for the truth predicate (denoted CT_0) is has the same arithmetical consequences as CT_0 with the global reflection principle. In addition, we show a natural extension of CT_0, which actually proves the principle.

[1] Volker Halbach, ***Axiomatic Theories of Truth***, Cambridge University Press, 2011.

[2] Henryk Kotlarski, Stanisław Krajewski, Alistair Lachlan, *Construction of satisfaction classes for nonstandard models*, ***Canadian Mathematical Bulletin***, vol. 24 (1981), no. 3, pp. 283–293.

[3] Henryk Kotlarski, *Bounded induction and satisfaction classes*, ***Proceedings of the third Easter conference on model theory*** (Gross Köris), Humboldt Universität Berlin, 1985, pp.143–167.

CONTRIBUTED TALKS 10

Tuesday, 4 August • 4.00PM–6.00PM
Venue - P724

► EVGENY GORDON, PAVOL ZLATOSŠ, *Nonstandard analysis approach to the mathematical foundations of quantum mechanics.*
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A nonstandard analysis approach to mathematical foundations of quantum mechanics will be presented. Under this approach the states of a quantum system are unit vectors in a hyper-finite dimensional (HFD) Hilbert space and the observables are internal self-adjoint operators on it. The investigation of finite dimensional versions of quantum mechanics has a long history starting with some papers by J. Schwinger in the 1960s. The language of HFD spaces allows to formulate and prove some new results about the connection between finite dimensional versions of quantum mechanics and the quantum mechanics in $L_2(\mathbb{R}^d)$. For example, it is proved that the states, in which the probability that both the coordinate and the momentum assume infinite values is infinitesimal, form a separable Hilbert space. Under the HFD approach, unlike the quantum mechanics in $L_2(\mathbb{R}^d)$, the eigenfunctions corresponding to points of continuous spectrum are always states. To observables having continuous spectra within the $L_2(\mathbf{R}^\mathbf{d})$ approach there correspond observables having discrete spectra with infinitesimal quantum in the HFD approach. The connection between the quantum of the coordinate (ε) and the quantum of the momentum ($\hat{\varepsilon}$) is given by the infinitesimal relation $N\varepsilon\hat{\varepsilon} \approx 2\pi\hbar$, where N is the dimension of HFD Hilbert space, which can be regarded as a kind of the uncertainty principle.

► SAMSON ABRAMSKY, RUI SOARES BARBOSA, KOHEI KISHIDA, RAY LAL AND SHANE MANSFIELD, *Contextuality, cohomology and paradox.*
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Contextuality is a key feature of quantum mechanics that provides an important non-classical resource for quantum information and computation. Abramsky and Brandenburger [2] used sheaf theory to give a general treatment of contextuality in quantum theory. However, contextual phenomena are found in other fields as well, for example database theory. In this paper, we shall develop this unified view of contextuality. We provide two main contributions: firstly, we expose a remarkable connection between contexuality and logical paradoxes; secondly, we show that an important class of contextuality arguments has a topological origin. More specifically, we show that "All-vs-Nothing" proofs of contextuality are witnessed by cohomological obstructions.

[1] Samson Abramsky, *Relational databases and Bell's theorem*, ***In search of elegance in the theory and practice of computation: Essays dedicated to Peter Buneman*** (Val Tannen, Limsoon Wong, Leonid Libkin, Wenfei Fan, Wang-Chiew Tan, and Michael Fourman, editors), Springer, Berlin Heidelberg, 2013, pp. 13–35.

[2] Samson Abramsky and Adam Brandenburger, *The sheaf-theoretic structure of non-locality and contextuality*, ***New Journal of Physics***, vol. 13 (2011), no. 11, 113036.

[3] Samson Abramsky, Georg Gottlob, and Phokion G. Kolaitis, *Robust constraint satisfaction and local hidden variables in quantum mechanics*, ***Proceedings of the Twenty-Third International Joint Conference on Artificial Intelligence*** (Beijing, China), (Francesca Rossi, editor), AAAI Press, 2013, pp. 440–446.

[4] Samson Abramsky and Lucien Hardy, *Logical Bell inequalities*, ***Physical Review A***, vol. 85 (2012), no. 6, 062114.

[5] Samson Abramsky, Shane Mansfield, and Rui Soares Barbosa, *The cohomology of non-locality and contextuality*, ***Proceedings Eighth International Workshop on Quantum Physics and Logic (2011)*** (Nijmegen, The Netherlands), (Bart Jacobs, Peter Selinger, and Bas Spitters, editors), Electronic Proceedings in Theoretical Computer Science, 2012, pp. 1–14.

► M.A. NAIT ABDALLAH, *A typed λ-calculus approach to photon polarization in quantum mechanics.*
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We show that the linear and circular polarization states of the photon [1] can be represented using typed λ-vectors *i.e.,* vectors whose components are typed sums of *phase λ-terms,* where types correspond to physical states, and phase λ-terms are pairs $\langle \rho, +\theta \rangle$ where ρ is a λ-term and $+\theta$ is a rotation of angle θ. This is useful when applying Curry-Howard isomorphism to quantum mechanics.

It is an experimental fact that there are at most two physically distinct states of polarization of the photon, thus two types always suffice. A corresponding vector $\vec{X} = (X_1, X_2)$ of such types will be called a *type basis*. Quantum physical states of photon polarization can then be accounted for as follows.

A *measurement* λ*-matrix* is a 2×2 Hermitian matrix of sums of phase λ-terms $(m_{ij}) = (m^{\star}_{ji})$, where the conjugate of phase λ-term $\langle \rho, +\theta \rangle$ is defined as $\langle \rho, -\theta \rangle$.

Postulate. Every measurement λ-matrix M determines a unique type basis transformation $\mathscr{T} : (M, \vec{X}) \mapsto \vec{T}$ such that (i) each type T_i determines a typed Kronecker λ-vector $\delta_i = (\delta_{ij} : T_j \to T_j)$ corresponding to eigenvector $\vec{v}_i$ of M, where $\delta_{ii} = (\lambda x.x)$ and $\delta_{ij} = (\lambda x.0)$ if $i \neq j$, and (ii) every typed λ-vector $\vec{\varphi} = (\vec{f} : \vec{X} \to \vec{X})$ expressing a state of polarization of the photon in type basis $\vec{X}$ reduces to a typed λ-vector $\vec{\psi} = (\vec{g} : \vec{T} \to \vec{T})$ expressed in the basis defined by typed λ-vectors δ_i, such that $\vec{f} = g_1\vec{v}_1 + g_2\vec{v}_2$. $\square$

The reflexive transitive closure of the reduction relation postulated yields an equivalence relation such that each equivalence class includes all representations of a given photon polarization state.

The numerical interpretation of the λ-vectors calculated on the basis of this axiomatization matches the results expected from a quantum mechanics point of view, thus contributing to bridging the gap between constructive logic and quantum mechanics.

As an illustration, if v, h, d, s are types corresponding to vertical, horizontal, diagonal and slant polarization states of the photon, then typed λ-vector $\vec{\varphi} = \begin{pmatrix} \lambda x.0 : h \to h \\ \lambda x.x : v \to v \end{pmatrix}$ represents a photon that is vertically polarized and is equivalent to $\vec{\psi} = \begin{pmatrix} \lambda x.x : d \to d \\ \langle \lambda x.x, -\pi \rangle : s \to s \end{pmatrix}$. The measurement λ-matrix transforming $\vec{\varphi}$ into $\vec{\psi}$ is Pauli λ-matrix $\sigma_x = \begin{pmatrix} \lambda x.0 & \lambda x.x \\ \lambda x.x & \lambda x.0 \end{pmatrix}$. Similarly $\begin{pmatrix} \lambda x.x : h \to h \\ \langle \lambda x.x, +\pi/2 \rangle : v \to v \end{pmatrix}$ represents a photon in a clockwise circular polarization state, and is equivalent to $\begin{pmatrix} \lambda x.x + \langle \lambda x.x, +\pi/2 \rangle : d \to d \\ \langle \lambda x.x, +\pi \rangle + \langle \lambda x.x, +\pi/2 \rangle : s \to s \end{pmatrix}$ using the same λ-matrix .

[1] M.O. Scully and Zubairy M.S., ***Quantum Optics***, CUP, 1997.

▸ FARN WANG, *Temporal Logics for Continuous Collaborative Games.*
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In the complex world of webs, agents may form alliances to compete and collaborate in infinite computations. We present two temporal logics, BSIL (Basic Strategy Interaction Logic) and TCL (Temporal Cooperation Logic), for specifying and reasoning in such contexts. We also discuss the complexity of the model-checking problems and the satisfiability checking problems of these two logics.

BSIL is an extension to ATL (Alternating Temporal Logic) that supports specification of interactions among strategies for linear temporal properties. A new modal operator $\langle + \rangle$ introduced for the specification of interaction among strategies declared in syntax hierarchy. Consider the example of iterated prisoner's dilemma [1] in which the prisoners make decisions in successive rounds. The prisoner can then employ a strategy that suggests a decision based on what the other prisoners have done in the past. Given the strategies adopted by the prisoners, we can then observe a play, an infinite state sequence in which the state transitions are compatible with the strategies adopted by the prisoners. Assume that jail_a is a state proposition that is true only when prisoner a is in jail at the present state. An example formula of BSIL is the following for the iterated prisoner's dilemma.

$$\langle 1 \rangle(\square \mathrm{jail}_2 \wedge (\langle +2 \rangle \square \mathrm{jail}_1) \wedge (\langle +2 \rangle \square \neg \mathrm{jail}_1))$$

The formula says that prisoner 1 has a strategy, say σ, (declared with operator $\langle 1 \rangle$) to enforce the following.

- Prisoner 2 will always be in jail.
- Prisoner 2 are allowed, by σ, to keep prisoner 1 in jail forever.
- Prisoner 2 can collaborate with σ to set prisoner 1 free forever.

Note that subformula $\langle +2 \rangle \square \mathrm{jail}_1$ and $\langle +2 \rangle \square \neg \mathrm{jail}_1$ are declared with two different strategies of prisoner 2 that collaborate with σ to respectively enforce $\square \mathrm{jail}_1$ and $\square \neg \mathrm{jail}_1$. BSIL can express useful properties that ATL, GL, and AMC cannot. Morever, the model-checking problem complexity of BSIL is PSPACE-complete for concurrent game graphs.

However, BSIL does not allow specifying the interaction of strategies declared in different states. For example, a strategy is forgiving if it never suggests betrayal when the other prisoners did not betray in the previous round. Such property is not expressible in BSIL. We present TCL for the specification of such properties. The model-checking problem complexity of TCL is EXPTIME-complete.

The satisfiability problems of both BSIL and TCL is 2-EXPTIME-complete.

[1] R. Axelrod, *Effective Choice in the Prisoner's Dilemma*, ***Journal of Conflict Resolution***, vol. 24 (1980), no. 1, pp. 3–25.

CONTRIBUTED TALKS 11

Wednesday, 5 August • 4.00PM-6.00PM
Venue - PI

▸ KAISA KANGAS, *Fields in Zariski-like structures.*
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In [2], Hrushovski and Zilber introduced Zariski geometries, structures that generalize the Zariski topology of an algebraically closed field. They showed that Zilber's trichotomy holds for Zariski geometries: every non locally modular strongly minimal set interprets an algebraically closed field.

In [3], we introduced the notion of Zariski-like structures as a generalization of Zariski geometries to a non-elementary context. A Zariski-like structure is a quasiminimal pregeometry structure (in the sense of [1]) that satisfies certain criteria. We showed that if the canonical pregeometry obtained from the bounded closure operator is non-trivial, then a 1-dimensional group can be interpreted in a Zariski-like structure. For this, we generalized Hrushovski's group configuration theorem to our setting. Finally, in [5], we proved the analogue for the fact that Zilber trichotomy holds for Zariski geometries: a Zariski-like structure with a non locally modular pregeometry interprets either an algebraically closed field or a non-classical group (see [4]). It is an open question whether non-classical groups exist.

[1] Martin Bays, Bradd Hart, Tapani Hyttinen, Meeri Kesälä, and Jonathan Kirby, *Quasiminimal structures and excellence*, ***Bulletin of London Mathematical Society***, vol. 1 (2014), no. 46, pp.155-163.

[2] Ehud Hrushovski and Boris Zilber, *Zariski geometries*, ***Journal of the American Mathematical Society***, 9 (1996), pp. 1-56.

[3] Tapani Hyttinen and Kaisa Kangas, *Quasiminal structures, groups and Zariski-like geometries*, submitted, http://arxiv.org/abs/1502.01039

[4] Tapani Hyttinen, Olivier Lessman, and Saharon Shelah *Interpreting groups and fields in some nonelementary classes*, ***Journal of Mathematical Logic***, vol. 1 (2005), no. 5

[5] Kaisa Kangas, *Finding a field in a Zariski-like structure*, submitted, http://arxiv.org/abs/1502.03225

▸ KOICHIRO IKEDA, *On near model completeness of generic structures.*
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A theory T is said to be nearly model complete, if every formula is equivalent in T to a Boolean combination of Σ_1-formulas. This notion is a generalization of model completeness. For generic structures, it is known that Hrushovski's strongly minimal structure M_1 and Shelah-Spencer's random graph M_2 are nearly model complete ([2, 1, 3]). Also, both of $\mathrm{Th}(M_1)$ and $\mathrm{Th}(M_2)$ are ultra-homogeneous (over closed sets), i.e., if A, B are finite closed isomorphic subsets of a big model then $\mathrm{tp}(A) = \mathrm{tp}(B)$. In this talk, we will show that if the theory of a generic structure is ultra-homogeneous then it is nearly model complete.

[1] John T. Baldwin and Saharon Shelah, *Randomness and semigenericity*, ***Transactions of the American Mathematical Society*** 349 (1997), 1359–1376
[2] Ehud Hrushovski, *A new strongly minimal set*, ***Annals of Pure and Applied Logic*** 62 (1993), 147–166
[3] Massoud Pourmahdian, *Simple generic structures*, ***Annals of Pure and Applied Logic*** 121 (2003), 227–260

▸ RICARDO BELLO AGUIRRE, *Generalised stability of pseudofinite residue rings.*
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We will present a study of ultraproducts of finite residue rings and give sufficient conditions to determine if these ultraproducts have simple, NIP, NTP2 or TP2 theories.

▸ ALI VALIZADEH, MASSOUD POURMAHDIAN, *Investigating an unstable generic structure.*
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In the context of Hrushovski constructions we take a language $\mathcal{L}$ with a ternary relation R; we consider the generic model M_0^* of a so-called smooth class $\mathcal{C}$ of some finite $\mathcal{L}$-structures equipped with a predimension function and a notion of strong embedding.

In [4] Pourmahdian generalized Baldwin-Shelah's notion of semigenericity(in [1]) for smooth classes which do not have algebraic closure property(AC) and proved that this class and its generic lead to an unstable simple context. The simplicity of the first order theory of the generic remained open, but he showed that the class of existentially closed models of a certain theory obtaining from $\mathcal{C}$ is simple as an infinitary class.

Evans and Wong showed in [3] that all finite graphs are interpretable in M_0^* henceforth $Th(M_0^*)$ is undecidable and has the strict order property. The proof of the latter properties lies on the facts transferred from finite graphs into the model. As a natural question so, the authors have asked in [3] if this structure has the finite model property(FMP); we show that this is not the case. The other consequence of undecidability of $Th(M_0^*)$ is that T_{sgen}(the theory of semigeneric structures) does not axiomatize $Th(M_0^*)$ and hence is not complete.

Brody and Laskowski showed in [2] that Robinson arithmetic is interpreted in every model of T_{sgen} and consequently this theory is essentially undecidable. They also demonstrated very gently that this theory has $2^{\aleph_0}$ completions. We will interpret a dense linear order in M_0^* in order to show that this model does not have FMP, providing another witness for this model to be wild. But we also prove that this model has quantifier elimination up to a certain family of formulas, a result that could be an asset to deeper investigations of this model. It seems to us that this model is either capable of finding good examples or is extremely wild in the sense that could interpret much more than Robinson arithmetic, namely the whole of PA.

[1] J. Baldwin and S. Shelah, *Randomness and semigenericity*, ***Transactions of American Mathematical Society***, vol. 349 (1997), no. 4, pp. 1359–1376.
[2] J. Brody and M. Laskowski, *On rational limits of Shelah–Spencer graphs*, ***The Journal of Symbolic Logic***, vol. 77 (2012), no. 2, pp. 580–592.
[3] D. Evans and M.W.H. Wong, *Some remarks on generic structures*, ***The Journal of Symbolic Logic***, vol. 74 (2009), no. 4, pp. 1143–1154.
[4] M. Pourmahdian, *Smooth classes without AC and Robinson theories*, ***The Journal of Symbolic Logic***, vol. 67 (2002), no. 4, pp. 1274–1294.

▸ ALIREZA MOFIDI, *Some dynamical approaches to NIP theories.*
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In papers such as [3], some dynamical aspects of model theoretic objects are studied. Also application of measures in stability theory are extensively studied in several papers such as [1].

In this talk, we study some dynamical aspects of the action of automorphisms on certain model theoretic objects, such as stone spaces, models, etc, in particular in the presence of invariant measures. On the base of [2], we consider characterization of stability theoretic notions in terms of combinatorial and dynamical properties of such actions. For example we give some characterizations for NIP theories in terms of notions such as compact systems, entropy and measure algebras. Moreover, via studying the concept of symbolic representation for models, we give some characterizations for dividing lines and combinatorial configurations such as SOP, IP and OP.

[1] E. Hrushovski and A. Pillay, *On NIP and invariant measures*, ***Journal of the European Mathematical Society***, vol.13 (2011), pp.1005–1061.

[2] A. Mofidi, *On some dynamical aspects of NIP theories*, ***http://arxiv.org/abs/1503.02506***.

[3] L. Newelski, *Topological dynamic of definable group actions*, ***Journal of Symbolic Logic***, 74 (2009), pp. 50-72.

CONTRIBUTED TALKS 12

Wednesday, 5 August • 4.00PM-6.00PM
Venue - PII

▸ PAOLO PISTONE, *Parametric polymorphism and the completeness of type theory.*
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The standard technique to prove normalization for type theories is by means of a *reducibility interpretation*: one proves that typable terms are reducible (a *soundness* result), hence (strongly) normalizing. In this paper we focus on the converse direction (i.e. *completeness*): when are reducible terms typable?

In [2] it was conjectured that completeness holds for Π^1 types (remark that it cannot hold for more complex types, due to incompleteness). We establish a lower and upper bound for completeness with respect to reducibility interpretations, by proving a completeness theorem for $\overline{\Pi}^1$ types (the universal closure of simple types), considering closed normal λ-terms.

The proof of our theorem relies on two interpretations of polymorphism: a reformulation of the parametric interpretation ([3]) within the reducibility interpretation and a syntactic reformulation of the dinatural interpretation of type theory ([1]). The latter, in particular, provides a syntactic characterization of reducible λ-terms.

[1] Jean-Yves Girard, Andre Scedrov, and Philip J. Scott. *Normal forms and cut-free proofs as natural transformations*. In Y. Moschovakis, editor, ***Logic from Computer Science***, volume 21, pages 217241. Springer-Verlag, 1992.

[2] Jean-Yves Girard. *The blind spot*. European Mathematical Society, 2011.

[3] John C. Reynolds. *Types, abstraction and parametric polymorphism*. In R.E.A. Mason, editor, ***Information Processing 83***, pages 513523. North-Holland, 1983.

► STANISLAW AMBROSZKIEWICZ, *Types and operations*.
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Abstract of the paper *Types and operations*, http://arxiv.org/abs/1501.03043

A revision of the notion of function (called here operation) is proposed. It is based on explicit constructors and follows Grzegorczyk's combinators [2] for constructing recursive objects in all finite types. Universe of *all* constructible objects is proposed. It consists of infinite hierarchy of levels, and corresponds to the universe of types introduced into constructive type theory by Martin-Löf [3], as well as to Calculus of Inductive Constructions (CoIC) [1]. Also a revision of the notion of relation is proposed. It is claimed that there are primitive relations associated to each primitive type. It is not only equality relation, i.e. equality types of Martin-Löf. For natural numbers there are also inequality relations, i.e. *greater* and *lesser*. These primitive relations together must be complete, i.e. their disjunction is always true. Generally, relation is an operation whose output are primitive types corresponding the primitive relations. Relations and propositions are constructed step by strep as operations and types starting from the first level of the Universe.

The proposed Universe resembles CoIC and its infinite well-founded typing hierarchy of sorts whose base sorts are $Prop$ and Set, and universes $Type(n)$ for all natural numbers n. $Prop$ and Set are objects of type $Type(1)$. $Type(n)$ is an object of $Type(n+1)$. $Prop$ is the type of logical propositions; it is an impredicative formal theory. Set corresponds to the basic level of the Universe, whereas $Type(n)$ correspond to level n of the Universe.

For any formula (proposition) of $Prop$ there is level n of the Universe where the corresponding relation (type) is constructed. However, n is arbitrary large.

[1] T. Coquand and G. Huet , *The Calculus of Constructions*, ***Information and Computation***, vol. 76 (1988), no. 2-3, pp. 95–120.

[2] A. Grzegorczyk, *Recursive objects in all finite types*, ***Fundamenta Mathematicae***, vol. 54 (1964), pp. 73–93.

[3] P. Martin-Löf, *An intuitionistic theory of types: predicative part*, ***Logic Colloquium 1973***, (H. E. Rose and J. C. Shepherdson editors), North-Holland, Amsterdam, 1973, pp. 73–118.

► ANAHIT CHUBARYAN, ARMINE CHUBARYAN, HAKOB NALBANDYAN, SERGEJ SAYADYAN, *On some universal system for various propositional logics*.
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In [1] the notions of determinative conjunct and determinative disjunctive normal form (dDNF) were introduced, on the base of which some proof system for classical propositional logic was defined. The analogous notions for intuitionistic, minimal and modal logics are given in [2] and [3] accordingly. Now we generalize these notions for various propositional logics (monotone, positive, fuzzy and some others) and suggest some idea for the construction of universal proof system for various propositional logics.

For each logic we must define: 1) contrary literals, 2) replacement rules and rules of validity, 3) determinative conjunct, 4) dDNF, every conjunct of which can be used as an axiom of the corresponding system and 5) variants of inference rules (e-rules), every of which eliminates contrary literals.

The proof in the introduction system is a finite sequence of conjuncts, each of which is one of the axioms or is inferred from earlier conjuncts in the sequence by one of e-rules. For every tautology of the given logic the empty conjunction ($\emptyset$) must be proved from the conjuncts of dDNF of this tautology.

Acknowledgment. This work is supported by Grant 13-1B246 of SSC of Gaverment of RA.

[1] An. Chubaryan, Arm. Chubaryan, *A new conception of Equality of Tautologies*, ***L&PS, Triest, Italy***, vol. V (2007), no. 1, pp. 3-8.

[2] An. Chubaryan, Arm. Chubaryan, S. Sayadyan, *Relative effciency propositional proof systems for Classical and Nonclassical Propositional Logic*, ***Perspectives on Universal Logic, Polimetrica, ISP, Monza, Italy***, 2007, pp. 265-275.

[3] An. Chubaryan, A. Mnatsakanyan, H. Nalbandyan, *On some propositional proof system for modal logic*, ***Transactions of YII Conference of NAS EAU***, 2015, pp. 21-31.

► BENNO VAN DEN BERG, *Arithmetical Conservation Results and Goodman's Theorem*.
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A wellknown result by Goodman [1] states that Heyting arithmetic in all finites types together with the axiom of choice for all types is conservative over Heyting arithmetic. Goodman's original proof was quite complicated and many people have since tried to give more perspicuous proofs of his theorem, including Goodman himself, Beeson, Renardel de Lavalette, Mints, Gordeev, Coquand and possibly others. In this talk I will present my preferred proof, developed together with Lotte van Slooten, which combines ideas from all these authors and adds some new ones.

[1] N.J. Goodman *The theory of G´odel functionals*, ***Journal of Symbolic Logic***, vol. 41 (1976), no. 3, pp. 574–582.

▶ STEFANO BERARDI, SILVIA STEILA, AND KEITA YOKOYAMA,
Reverse mathematical bounds for the Termination Theorem.
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In [1] Podelski and Rybalchenko characterized the termination of transition-based programs as a property of well-founded relations. They proved that a relation R is well-founded if and only if there exist a natural number k and k-many well-founded relations whose union contains the transitive closure of R. The classical proof of Podelski and Rybalchenko's Termination Theorem requires Ramsey's Theorem for pairs which is a purely classical result, therefore extracting bounds from the original proof is non-trivial task.

Our goal is to investigate the termination analysis from the point of view of Reverse Mathematics. By studying the strength of Podelski and Rybalchenko's Termination Theorem we can extract some information about termination bounds.

[1] Andreas Podelski and Andrey Rybalchenko, *Transition Invariants*, ***LICS*** 2004, pp. 32–41.

▶ BILL WADGE, OMAR ALAQEELI, *Completeness of the Universal Hybrid Calculus.*
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We present a completeness proof for the Universal Hybrid Calculus (UHC) with respect to a Beth style tableau system.

The UHC is a simple formal system with the same expressive power as Monadic Predicate Logic but without bound variables.

Upper case letters and their Boolean combinations denote properties - for example, $G \wedge M$ might denote the property of being *Greek and Mortal*.

UHC formulas themselves are Boolean combinations of atomic formulas. The simplest involves applying a property to an individual constant (lower case letters in our syntax). Thus if s denotes *Socrates*, sG asserts that *Socrates is Greek*.

Universal generalization works by splitting the modal operator $\Box$ into brackets [and]. Thus $[G]M$ (another atomic formula) might assert that *all Greeks are mortal*, and $[S \vee A]G$ that *all Spartans or Athenians are Greek*. In the same way we split $\diamond$ into $\langle$ and $\rangle$ so that $\langle A\rangle(G \wedge M)$ might assert that *some Athenians are Greek and mortal*.

The proof rules make use of the existence of individual constants. Thus the rule for $[P]Q$ on the right allows us to cancel this formula, select a new unused constant v, and add vP on the left and vQ on the right. For $[P]Q$ on the left we cannot cancel. But we can choose any constant x (usually one already in use) and split the tree. On one branch we add xP on the right and on the other xQ on the left. The rules for $\langle P\rangle Q$ are similar.

The completeness proof uses the standard technique of showing that from an open branch we can construct a counterexample.

CONTRIBUTED TALKS 13

Wednesday, 5 August • 4.00PM-6.00PM
Venue - PIII

▶ CAROLIN ANTOS, *Class-Forcing in Class Theory.*
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In this talk we will show that the class theory of Morse-Kelley is an appropriate framework for class-forcing and how it can be adapted to the modern practice of forcing. The main advantage of doing class-forcing in this setting is that the Definability Lemma holds for all forcing notions instead of having to restrict them to tame forcings as in the setting of ZFC. We first have to develop the basic definitions and results of the forcing apparatus and adapt them to a context where we have two types of object, namely sets and classes. We proceed to show the Definibility Lemma and then the Truth Lemma follows very similar to the ZFC context. In the end, we will show that the restriction to tame forcings is still necessary to preserve the axioms of MK in the forcing extension. This also explicates the main difference to Chuaqui's treatment of the topic, as he restricts not the type of forcing notion but the type of generic that can be used in the forcing construction. As an application we prove that Laver's Theorem (stating that the ground model is always definable in its set-forcing extensions) does not hold for class-forcing extensions in MK (and indeed also in ZFC).

[1] R. Chuaqui, ***Internal and forcing models for an impredicative theory of classes***, Dissertationes Mathematicae 176, 1980.

[2] S.D. Friedman, ***Fine structure and class forcing***, de Gruyter Series in Logic and its Applications. 3., Walter de Gruyter, New York, 2000.

[3] R. Laver, *Certain very large cardinals are not created in small forcing extensions*, ***Annals of Pure and Applied Logic***, vol. 149 (2007), pp.1–6.

▶ NEIL BARTON, *On the relationship between proper classes and forcing extensions.*
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Recently there has been an increased focus in Set Theory on interpreting talk of forcing extensions within ground models. My aim in this talk is twofold; (1.) to provide an exposition of some of these methods, and (2.) to bring to light some philosophical consequences of the techniques in question. In particular, I argue that the kinds of class theory and class existence principles countenanced lead to the legitimacy of different resources for interpreting forcing extensions within ground models. My strategy is as follows:

§1 provides a brief introduction and philosophical motivation for considering representations of forcing extensions. §2 then explains the Boolean Ultrapower method for interpreting forcing extensions (developed in [1]). It is argued that the technique performs better with respect to certain *desiderata* when interpreting generic embeddings. In particular, it is better able to account for the *size* of objects than an approach using only countable transitive models, and more closely represents the *combinatorial* and *classical* nature of reasoning than the normal Boolean-valued approach. It is shown, however, that in order to best fulfil this function, there must be large cardinal embeddings and thus certain classes must exist. §3 then presents a different method for interpreting forcing; the use of V-logic (given in [2]). It is shown how the technique depends crucially on Δ^1_1-Comprehension for classes, and so how the kind of class theory countenanced is important. It is concluded that forcing and proper classes are more intimately connected than previously thought.

[1] Joel David Hamkins and Daniel Evan Seabold, *Well-founded Boolean ultrapowers as large cardinal embeddings*, ***arXiv:1206.6075 [math.LO]***,
[2] Sy-David Friedman, Carolin Antos, Claudio Ternullo, and Radek Honzik, *Multiverse conceptions in set theory*, ***Unpublished***,

▸ GRAHAM E. LEIGH, *A theory of truth equi-consistent with Quine's New Foundations*.
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URL Address: `http://dmg.tuwien.ac.at/leigh/`.

New Foundations, *NF*, is the set theory proposed by Quine in 1937 which permits the construction of many sets prohibited in Zermelo–Fraenkel set theory, including the universal set, $\{x \mid x = x\}$, as well as the set of all ordinals. The theory has a simple axiomatisation, namely *extensionality* and *stratified comprehension*, the latter being set comprehension for formulæ that can be consistently typed.

It is natural to ask whether stratification can provide a 'solution' to the truth-theoretic paradoxes. A direct translation of *NF* as a theory of truth (regarding sets as predicates and replacing $x \in y$ by 'y is true of x') is unsatisfactory due to its interpretation of the extensionality axiom. Putting extensionality aside, Cantini [1] recently proposed a compositional theory *SFT* (*Stratified Fregean Truth*) that derives the Tarskian truth biconditional for stratified formulæ and is interpretable in *NF*.

I will show that the following three theories are equi-consistent i) *NF*; ii) *SFT* extended by a principle of *indiscernibility of equivalents* (IndEq); and iii) the pure Tarskian truth biconditionals for stratified formulæ plus IndEq. In addition, I will argue that the final of these is a natural theory of truth in the spirit of Quine.

[1] Cantini, Andrea, *On stratified truth*, ***Unifying the Philosophy of Truth*** (Theodora Achourioti, Henri Galinon, José Martínez Fernández, and Kentaro Fujimoto, editors), Springer, Heidelberg, 2015, pp. 369–89.

▸ CHRISTIAN ESPINDOLA, *Completeness of Infinitary Intuitionistic Logics*.
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Completeness theorems for infinitary classical logics $\mathcal{L}_{\kappa,\kappa}$ (for, say, an inaccessible κ) have been known for decades. When removing excluded middle, however, the situation is more difficult to analyze even in the propositional case, as the main difficulty in studying infinitary intuitionistic logics is the huge variety of non-equivalent formulas that one can obtain. Completeness results for the propositional fragment $\mathcal{L}_{\omega_1,0}$ have been obtained, but the general case has not been addressed. The purpose of this talk is to outline set-theoretical and category-theoretical techniques that allow the study of completeness theorems for infinitary intuitionistic logics in the general case, both for propositional and first-order logics, in terms of an infinitary Kripke semantics. We will also analyze to what extent the use of large cardinal axioms (more precisely, the condition that κ be weakly compact) is necessary, and some applications of the completeness results will be presented.

[1] P. Johnstone,***Sketches of an Elephant - A Topos Theory Compendium - Vol I and II***, Oxford University Press, 2002.
[2] A. Kanamori,***The higher infinite***, Springer Verlag, 1994.
[3] C. Karp,***Languages with expressions of infinite length***, North-Holland Publishing Co, 1964.
[4] S. Maclane, I. Moerdijk,***Sheaves in geometry and logic***, Springer Verlag New York, 1994.

[4] S. Maclane, I. Moerdijk,***Sheaves in geometry and logic***, Springer Verlag New York, 1994.
[5] M. Makkai,*A theorem on Barr-exact categories, with an infinite generalization*,***Annals of Pure and Applied Logic***,vol. 47 (1990), pp. 225–268.
[6] M. Nadel,*Infinitary intuitionistic logic from a classical point of view*,***Annals of Mathematical Logic***, vol. 14 (1978), no. 2, pp. 159–191.

▸ GIORGIO VENTURI, *On the naturalness of Forcing Axioms*.
FAPESP fellow at CLE, Unicamp, Cidade Universitiria Zeferino Vaz - Baro Geraldo, Campinas - SP, Brazil..
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In this talk we will argue in favor of the naturalness of Forcing Axioms. We will briefly discuss the meaning of the reference to natural components in mathematics (following [2]). We will then review the dichotomy of intrinsic-extrinsic justifications for accepting new axioms in set theory and we will find both theoretical and practical difficulties in distinguishing between intrinsic and extrinsic reasons. We will then outline the conceptual realism that is presupposed by this dichotomy: a static and independent notion of set together with our ability to describe it axiomatically. Consequently the process of justification relays on the concept of set, alone, putting aside the human component that acts in the formalization of set theory. Against this form of conceptual realism we will argue that a different form of justification is needed in order to find principles able to give a solution to a local questions as the continuum problem. Moreover, we will argue that the naturalness of such axioms is to be found with respect to the fundamental ideas that motivate the formalization of set theory: the clarification of the notion of arbitrary set (as suggested in [1]). After a brief presentation of the Forcing Axioms, together with their intuitive motivations, we will propose our arguments in favor of their naturalness.

[1] J. Ferreiros, *On arbitrary sets and ZFC*, ***Bullettin of Symbolic Logic***, vol. 17 (2011), no. 3, pp. 361–393.
[2] L. San Mauro and G. Venturi, *Naturalness in mathematics*, ***From logic to practice*** (G. Lolli and M. Panza and G. Venturi, editors), Springer, 2015, pp. 277–314.

▸ ADDIS MARK, *Sets and set theoretic foundations*.
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The dominant view in philosophy was and is that mathematics requires fully axiomatised set theoretic foundations (almost invariably Zermelo-Fraenkel set theory including the axiom of choice). In mathematical practice sets are extensively used but the representation of simple set properties is a sufficient basis for very many proofs. These set properties formalise natural intuitions about sets or capture mathematical ideas of a non-set theoretic kind. Philosophical interest in set theoretic foundations is motivated by concerns about ontology and epistemology rather than by an interest in understanding contemporary mathematical practice. Given this the foundational significance of category theory deserves much more philosophical attention than it has had.

CONTRIBUTED TALKS 14

Wednesday, 5 August • 4.00PM-6.00PM
Venue - P617

▸ JOACHIM MUELLER-THEYS, *Unifying logic and Boolean algebra.*
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Analogies, like $\phi \vee \phi \Leftrightarrow \phi, a + a = a$, are well-known; Lindenbaum Tarski algebras are Boolean algebras. Nevertheless, logics and Boolean algebras are different entities: a logic (in the narrower sense) consists from a formal language and a concept of logical law, defined deductively or semantically, whereas a Boolean algebra is a structure, satisfying well-known equations.

In the following, we bring both approaches together, thereby removing the differences. Notation is settled by using logical symbols throughout.

I. **Logical Structures**. We introduce *structures*:

$$\mathcal{L} = \langle L \neq \emptyset; \neg\colon L \to L, \vee\colon L^2 \to L; \Lambda \subseteq L \rangle,$$

satisfying, e. g., the axioms:

$$\Lambda\ (\phi \vee \phi) \to \phi \text{ (viz. } \neg(\phi \vee \phi) \vee \phi = \vee(\neg(\vee(\phi,\phi)),\phi) \in \Lambda),$$
$$\Lambda\ \phi \to (\phi \vee \psi),$$
$$\Lambda\ (\phi \vee \psi) \to (\psi \vee \phi),$$
$$\Lambda\ (\phi \to \psi) \to \big((\chi \vee \phi) \to (\chi \vee \psi)\big);$$
$$\Lambda\ \phi, \Lambda\ \phi \to \psi \text{ implies } \Lambda\ \psi,$$

constructed akin to *logical* axioms and rules of propositional calculus PM.

Propositional and first-order logic can be subsumed by $\Lambda\phi$:iff $\vdash \phi$ (or $\models \phi$ resp.).

II. **Boolean Congruence Structures**. Formulæ do not follow the Boolean equations (e. g. $\phi \vee \phi \neq \phi$), whence—against original intentions—Boolean algebras have no immediate logical models: the detour via Lindenbaum Tarski algebras is required.

The problem can be resolved by considering congruencies instead of identity. This leads to structures:

$$\mathcal{B} = \langle L; \neg, \vee; \Leftrightarrow \subseteq L^2 \rangle,$$

where $\Leftrightarrow$ be a congruence relation with respect to $\neg$ and $\vee$, and, e. g., the following, further axioms be satisfied:

$$\phi \vee (\psi \vee \chi) \Leftrightarrow (\phi \vee \psi) \vee \chi,$$
$$\phi \vee \psi \Leftrightarrow \psi \vee \phi,$$
$$\neg(\neg\phi \vee \neg\psi) \vee \neg(\neg\phi \vee \psi) \Leftrightarrow \phi,$$

corresponding to Huntington's ingenious axioms for Boolean algebras, representing them as complementary commutative semi-groups.

Boolean algebras now appear as *minimal* $\mathcal{B}$, i. e. $\Leftrightarrow$ coincides with $=$.

III. **Unification Theorem**. (i) Let $\mathcal{L}$ be a logical structure, $\phi \Leftrightarrow \psi$:iff $\Lambda(\phi \leftrightarrow \psi)$. Then $\mathcal{B}$ is a Boolean congruence structure; (ii) Let $\mathcal{B}$ be a Boolean congruence structure, $\Lambda\phi$:iff $\phi \Leftrightarrow \top$. Then $\mathcal{L}$ is a logical structure.

Sketch of proof. (i) The claims can be shown by adapting methods of PM. For instance, $\Lambda(\psi \to \chi) \to ((\neg\phi \vee \psi) \to (\neg\phi \vee \chi))$ yields that $\Lambda\phi \to \psi$, $\Lambda\psi \to \chi$ implies $\Lambda\phi \to \chi$. So, by $\Lambda\phi \to (\phi \vee \phi)$ and $\Lambda(\phi \vee \phi) \to \phi, \Lambda\phi \to \phi$. Thus, after $\Lambda\psi, \Lambda\chi$ implies $\Lambda\psi \wedge \chi$ has been established, $\Lambda\phi \leftrightarrow \phi$. (ii) The claims can be shown like corresponding theorems of Boolean algebra, e. g. $(\phi \vee \phi) \to \phi \Leftrightarrow \top$ like $-(a + a) + a = 1$.

Thus Boolean congruence structures are *logical structures in terms of equivalence.*

Note. The solutions have been found together with Wilfried Buchholz.

▸ KA YUE CHENG, *Some infinitary paradoxes and undecidable sentences in Peano arithmetic.*
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The usual proof of Gödel's first incompleteness theorem involves an undecidable sentence in Peano arithmetic which can be viewed as a formal version of the Liar paradox. There are other proofs involving different paradoxes such as Berry paradox and Yablo's paradox.

In this talk I will apply a technique from [1] on four infinitary paradoxes to obtain some undecidable sentences.

The first three paradoxes, some of them possibly new, are related to the liar paradox and the existential Yablo's paradox, they can be presented in the following way.

Imagine there are infinitely many people in a room, each of them utters exactly one sentence. There are three cases:

1. Everyone says "At least one of the sentence uttered in this room is false".
2. Everyone says "At least one of the other sentences uttered in the room is false".
3. They queue up and the k^{th} person says "At least k sentences uttered in this room are false".

In each case we have a paradox. Most notably, the second paradox is similar to the Truth-teller in the sense that any consistent truth value assignment is ungrounded. While the formalized Truth-teller is the Henkin sentence which is provable, the corresponding sentence for the second paradox is undecidable.

The fourth paradox, from [3], called the Earliest Class Inspection paradox, is an infinite version of Surprise Examination paradox.

At the end we have four more ways to prove Gödel's first incompleteness theorem.

[1] Cieśliński, Cezary and RafałUrbaniak, *Gödelizing the Yablo Sequence*, ***Journal of Philosophical Logic*** vol. 42 (2013), no. 5, pp. 679–695

[2] Fitch, Frederic B., *A Goedelized Formulation of the Prediction Paradox*, ***American Philosophical Quarterly***, vol. 1 (1964), no. 2, pp. 161–164

[3] Sorensen, Roy A., *The Earliest Unexpected Class Inspection*, ***Analysis***, vol. 53 (1993), no. 4, pp. 252–

▸ ALEXANDR BESSONOV, *Peano arithmetic can well prove its own consistency.*
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Keywords: *03A05+00A30, Gödel's incompleteness theorems, inadequacy of provability predicate, unprovability predicate.*

In proving the incompleteness theorems, K. Gödel represents provability in Peano arithmetic (PA) using the provability predicate $\Pr(x, y)$ (which is satisfied iff x is the Gödel number of a formula and y is the Gödel number of its proof) and some arithmetical formula $\mathrm{Prov}(x, y)$ 'expressing' that predicate in PA. But this formula is not the best candidate to represent the *unprovability* in PA. The following is a simple consequence of the second Gödel's theorem showing inadequacy of Gödel's representation of unprovability:

Theorem 2+. (1) *If* PA *is consistent, then, for any formula A, a formula* $\forall y \neg \mathrm{Prov}(\ulcorner A \urcorner, y)$ *that 'expresses' the unprovability of A is unprovable in* PA.

(2) *If* PA *is ω-consistent, then, for any formula A unprovable in* PA, *a formula that 'expresses' the unprovability of A is undecidable in* PA.

Theorem 2+ implies that the formula $\forall y \neg \mathrm{Prov}(\ulcorner \neg(\mathbf{0} = \mathbf{0})\urcorner, y)$, which 'expresses' the unprovability of a formula $\neg(\mathbf{0} = \mathbf{0})$, is undecidable and, hence, is unprovable in PA. In fact, however, a proof (by contradiction) that $\neg(\mathbf{0} = \mathbf{0})$ is unprovable is quite elementary, provided PA is consistent.

If PA is consistent, and $\neg A$ is a formula provable in PA, then A is obviously unprovable by the definition of consistency. Consider the *unprovability* predicate $\mathrm{NPr}(x, y)$ which is satisfied iff x is the Gödel number of some formula and y is the Gödel number of a proof of its *negation*. (The extension of this predicate does not include all formulas unprovable in PA, but we need only prove a formula 'expressing' unprovability of at least one formula in PA.) Clearly, this predicate is 'expressible' in PA via some formula $\mathrm{NProv}(x, y)$. Let n be the Gödel number of a derivation of the formula $\neg\neg(\mathbf{0} = \mathbf{0})$. The definition of a predicate $\mathrm{NPr}(x, y)$ implies that $\mathrm{NPr}(\ulcorner\neg(0 = 0)\urcorner, n)$ is true. In view of the 'expressibility' conditions, therefore, $\mathrm{NProv}(\ulcorner\neg(\mathbf{0} = \mathbf{0})\urcorner, \boldsymbol{n})$ is provable in PA. If existential generalization is applied to this formula, then we are led to a derivation of $\exists y \mathrm{NProv}(\ulcorner\neg(\mathbf{0} = \mathbf{0})\urcorner, y)$ which 'expresses' the unprovability of a formula $\neg(\mathbf{0} = \mathbf{0})$. If existential generalization is applied twice, then we arrive at a derivation of $\exists x \exists y \mathrm{NProv}(x, y)$ that 'expresses' the existence of an unprovable formula in PA. Thus PA can well prove its own consistency!

▸ JAAKKO HINTIKKA, *Distributive normal forms 2015*.
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Distributive normal forms represent first-order formulas as disjunctions of constituents. Constituents are calculated to express the most basic alternatives that can be distinguished in the given language. A constituent $C^{(d)}(a_1, a_2, ..., a_k)$ (with depth d and with the parameters $a_1, a_2, ..., a_k$) has in the past been defined syntactically as being of the form

$$(*) \bigwedge_i (\exists x) C_i^{(d-1)}(x, a_1, a_2, ..., a_k) \wedge (\forall x) \bigvee_i C_i^{(d-1)}(x, a_1, a_2, ..., a_k) \wedge C^0(a_1, a_2, ..., a_k)$$

where $C^0(a_1, a_2, ..., a_k)$ asserts or denies each atomic formula with singular terms $a_1, a_2, ..., a_k$, while semantically it can be defined as a full list of all structurally different ramified sequences of d individuals. The two definitions are not equivalent. The reason can be traced to the fact that in (*) the choice of x depends on $a_1, a_2, ..., a_k$. They can be made to agree by liberating the choice, syntactically speaking by replacing in $(\exists x)$ by

$$(\exists x / a_1, a_2, ..., a_k)$$

Each constituent so defined is satisfiable while not all (*) are. Many decision problems turn on recognizing inconsistent instances of (*). This can in principle be done by expanding (*) into a disjunction of deeper constituents by first lengthening all sequences of individuals. This turns each subconstituent in (*) into a disjunction and then moves all new disjunction signs outwards, as shown by the equivalence

$$(\exists x)(A(x) \vee B(x)) \leftrightarrow ((\exists x)(A(x) \vee (\exists x) B(x))$$

The result is a tree structure of constituents. Each branch can be conceptualized as an infinite constituent if the initial constituent is constituent at some depth $d + e$ all disjuncts of its expansion are propositional contradictions. In the present contribution, these tree structures are examined, leading to interesting new model theoretical results.

References

Hintikka, Jaakko, Distributive Normal Forms in Calculus of Predicates, Acta Philosophica Fennica, vol. 6, 1953.

Hintikka, Jaakko, Distributive normal forms in first-order logic, in Logic, Language-Games and Information, Clarendon Press, Oxford, 1973.

Hintikka, Jaakko, Continuum hypothesis as a model-theoretical problem forthcoming.

▸ BENEDICT EASTAUGH, *Three kinds of mathematical naturalness*.
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URL Address: `http://extralogical.net`.

Statements like Goodstein's theorem and the strengthened finite Ramsey theorem of Paris and Harrington have been claimed as natural examples of the incompleteness phenomenon, since they are arithmetical statements that are independent of the axioms of Peano arithmetic, but not "artificial" ones in the sense that the Gödel sentence or the canonical consistency statement for PA are. Such statements are supposed to be natural because they are stated in terms of ordinary mathematical concepts, rather than metamathematical ones like provability. Stephen Simpson [1] proposes another definition of mathematical naturalness: a statement is mathematically natural if it is equivalent over a weak base theory to a (suitably formalised) theorem of core mathematics. This definition of naturalness implicitly depends on the first; we can say that a statement is hereditarily or derivatively mathematically natural if it is equivalent over a weak base theory to a statement that is mathematically natural in the first, intensional sense. In this talk I shall discuss the relationships of these two definitions of mathematical naturalness to a third type of naturalness, namely logical or combinatorial naturalness, and consider how it relates to questions about the significance of reverse mathematics.

[1] Simpson, Stephen G., ***Subsystems of Second Order Arithmetic***, ASL Perspectives in Logic, Cambridge University Press, 2009.

▸ HAROLD T. HODES, *Varieties of ramified-type assignment systems*.
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Ramified types are formed by adding at least one additional dimension to simple types, that of (what Bertrand Russell called) order. The notion of order is constrained by two principles: (1) the order of a sentence (and of the proposition it signifies) is greater than the order of the types restricting all quantifier-prefixes occurring in that sentence; (2) the order of a lambda-term (and thus of the propositional function it signifies) is greater than the order of the variables that the lambda-prefix binds (and thus of the arguments of the mentioned function).

I will discuss two kinds of ramified types. All start from a single type $\boldsymbol{i}$ (for individuals). A propositional type (both basic and "discounting") will have the form $\langle m \rangle$ for a natural number m (its order). For $n > 0$, an n-place functional basic type will have the form$\langle t_1, \ldots, t_n, m \rangle$ such that $t_1, \ldots, t_n$ are basic types and $m >$ the maximum of the orders of $t_1, \ldots, t_n$; $_m$ is its order. In addition to order, discounting types have discounted order. The n-place functional discount types will have the form $\langle t_1, \ldots, t_n, m, d \rangle$ such that $t_1, \ldots, t_n$ are discounting types, $m>$ the maximum of the orders of $t_1, \ldots, t_n$, and d meeting a condition that I won't try to explain here; m is its order, and d is its discounting order. Here is a little motivation: there can be terms τ_0 and τ_1, both of basic type $\langle \boldsymbol{i}, 1 \rangle$, but such that $\tau_0(x)$ has type $\langle 0 \rangle$ (i.e. is elementary in the terminology of PM (= Principia Mathematica)), and $\tau_1(x)$ has type $\langle 1 \rangle$. Using discounting types, τ_0 will be of type $\langle \boldsymbol{i}, 1, 0 \rangle$, while τ_0 will be of type $\langle \boldsymbol{i}, 1, 1 \rangle$.

The literature on RTA systems uses basic types (but in the literature on cumulative order after discarding $\langle 0 \rangle$. I will present the RTA systems, which use basic ramified types, that Kamareddine, Laan and Nederpelt ("Types in Logic and Mathematics before 1940", BSL 2002, Vol. 8, No. 2, pp. 185-245) claimed was a rigorous development of the ideas in PM. I will argue that their systems fail to satisfy certain desiderata, e.g. that all values of a given propositional function have the same type. I will then present RTA systems using discounted types that do satisfy the relevant desiderata, and that I think do a better job at developing the ideas in PM.

CONTRIBUTED TALKS 15

Wednesday, 5 August • 4.00PM-6.00PM
Venue - P673

▸ IOANNIS KOKKINIS, *First steps towards probabilistic justification logic.*
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Justification logics use formulas of the form $t : \alpha$ meaning "the agent believes α for reason t". Of course, not all justifications for belief are equal. For example, we may believe α because some friend of ours has heard about α or because we read about α in the New York Times. It is natural that we cannot put the same credence in both justifications for α. We can reflect this differentiation in credibility by adding to our language an operator that expresses the degree r for which a piece of evidence t can serve as a justification for α, in our notation $P_{\geq r}(t : \alpha)$.

In this talk we will present the probabilistic justification logic PJ, see [2], a logic in which we can reason about the probability of justification statements. We will present an axiomatization for PJ that is sound and strongly complete with respect to a variation of standard Kripke models enriched with a measure function on the set of worlds. We prove that PJ is decidable, by reducing the satisfiability problem for PJ to satisfiability of a linear system.

PJ is a combination of the justification logic J and the probabilistic logic LPP_2, see [1]. The definitions of syntax and semantics of PJ follow the pattern of LPP_2 and our completeness and decidability proofs are adaptations of the corresponding proofs for LPP_2.

This is a joint work with Petar Maksimović, Zoran Ognjanović and Thomas Studer.

[1] Ognjanović, Zoran and Rašković, Miodrag and Marković, Zoran, *Probability Logics*, ***Zbornik radova, subseries "Logic in Computer Science"***, vol. 12 (2009), no. 30, pp. 35–111.

[2] Kokkinis, Ioannis and Maksimović, Petar and Ognjanović, Zoran and Studer, Thomas, *First Steps towards Probabilistic Justification Logic*, ***submitted***

▸ THOMAS BENDA, *A relational doxastic logic.*
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A doxastic logic DR is proposed with relational belief predicates, beliefs as quoted formulas and backgrounds of beliefs. Its main predicate is ternary: $\mathrm{B}xyb$, read "I believe, with background b, x to at least as high a degree as y".

The first two places of B are quoted formulas. Each pair thereof is called "relational belief", each member of such a pair, "belief". Quotation allows relational beliefs to be non-extensional, in accordance with our daily practice. Belief backgrounds are formulas not containing B. Each belief background provides a presupposition for its corresponding relational belief. Its functions are semantic: resolving indexicals, providing background information; and epistemic-pragmatic: making relational beliefs credible and acceptable by providing epistemic and pragmatic context.

DR is a conservative extension of Zermelo's Z. Its additional vocabulary contains a quotation symbol $'\,'$, the predicate constant B and expression variables that are free within quotations. The calculus of DR has six proper axiom(scheme)s which make, for all b, $\mathrm{B}xyb$ partially ordered, restrict beliefs of contradictions and are analogues of the K4 axioms.

The semantics of DR is concerned with truth of belief sentences rather than with truth of beliefs. It is three-valued. Belief sentences are true or false only if their backgrounds are true, otherwise they are neutral. In each model of DR, beliefs form a partial order of credences. This accords well with daily practice and, as I have argued elsewhere, well represents vague beliefs.

Epistemic and doxastic theories commonly suffer from being inconsistent as an outcome of the Knower's Paradox. DR is strong enough to allow for a diagonal lemma concerning beliefs simpliciter, beliefs beliefs with only one free individual variable. However, from the axioms of DR a contradiction is not readily derived. Indeed, plausible and interesting models of DR can be found.

▸ ALEXANDRE MADEIRA, RENATO NEVES, MANUEL A. MARTINS, LUÍS S. BARBOSA, *Effects in Modal Logics.*
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Suppose you take a train and start planning your trip as you go. With a proper map the task is quite straightforward. But what if the transportation system breaks down, and a malevolent demon starts cancelling connections, anywhere in the network? This question appears in the motivation section of Johan van Benthem seminal paper on sabotage logic [vB05]. The scenario is as follows: there is a transition structure (the map, a graph) over which sentences are interpreted as usual in modal logic; however this may change dynamically while being traversed.

Sabotage logic is an example of a modal logic equipped with modalities that can change the accessibility relation of the underlying Kripke model along the evaluation of a formula. In particular, edges are deleted. Adding new edges or swapping existent ones are further examples of effects leading to logics which, over time, have found interesting applications in describing and reasoning about dynamic aspects of phenomena. A number of recent papers (e.g. [AFG14, AFH13, AFH12]) explore specific instances of these ideas further witnessing their relevance to application areas ranging from reconfigurable software specifications to changing obligations contexts in epistemic logics.

This talk introduces a modal language that admits quantification over modalities, and therefore provides a generic setting to express this sort of computational effects on the evaluation of a formula, going beyond the specific cases documented in the literature. A notion of bisimulation, parametric on the effect, is presented and the corresponding invariance result discussed.

[vB05]J. van Benthem, *An essay on sabotage and obstruction* ***Mechanizing Mathematical Reasoning*** (In D. Hutter and W. Stephan, editors, Essays in Honor of Jorg H. Siekmann on the Occasion of His 60th Birthday, volume 2605 of Lecture Notes in Computer Science, pages 268–276. Springer, 2005.

[AFG14]C. Areces, R. Fervari, and G. Hoffmann, *Swap logic* ***Mechanizing Mathematical Reasoning*** 22(2):309–332, 2014.

[AFH13]C. Areces, R. Fervari, and G. Hoffmann, *Tableaux for relation-changing modal logics*, ***Frontiers of Combining Systems 2013***, Nancy, France, September 2013.

[AFH12]C. Areces, R. Fervari, and G. Hoffmann, *Moving arrows and four model checking results*, ***WoLLIC 2012*** (In L. Ong and R. de Queiroz, editors, Proceedings of the 19th International Workshop on Logic, Language, Information and Computation, volume 7456 of Lecture Notes in Computer Science, pages 142–153, Buenos Aires, Argentina, September 2012.

▸ ATTILA MOLNÁR, *On first-order temporal logics of spacetimes.*
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I will present a first-order temporal logic where possible worlds represent events of a spacetime, accessibility is causality, the one universal domain is for numbers, the individual concepts / nonrigid designators represents *timelike curves* or *physical processes* or just simply *clocks*. For simplicity, I refer to logics of these first-order tense languages as *clock logics*. In my talk I will present results concerning

1) **Expressive Power:** In these languages, the basic paradigmatic relativistic effects of kinematics such as time dilation, length contraction, twin paradox, etc. are expressible and can be quantized.
2) **Operationality:** The coordinatization of Minkowski spacetimes itself is definable using metric tense operators with *signalling procedures*.
3) **Completeness, decidability and incompleteness:** For any $n \geq 2$, the clock logic of *timelike geodesics* of the n-dimensional Minkowski spacetime is axiomatizable and decidable. For any $n \geq 2$, the clock logic of *all timelike curves* of the n-dimensional Minkowski spacetime is not axiomatizable.
4) **Comparability to the literature:** Standard translations of clock logics of Minkowski-spacetimes are *definitionally equivalent* with standard axiom systems of the Andréka-Németi research group.

Clock logics, as they are causal tense logics, are good candidates to connect the theory of branching spacetimes to the Andréka-Németi research. On the front of the foundation of general relativity, Malament [1] showed that timelike curves determines the topology of spacetime, and this shows that taking clocks as first-class passengers in a logical foundation of relativity theory is promising even in general relativity.

[1] Malament, David B., *The class of continuous timelike curves determines the topology of spacetime*, ***Journal of Mathematical Physics***, vol. 18 (1977), no. 7, pp.1399–.

▸ OLIVIER GASQUET, VALENTIN GORANKO, AND FRANCOIS SCHWARZENTRUBER, *Big Brother Logic: visual-epistemic reasoning in multi-agent systems.*
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Following on [1], we consider logical systems for reasoning about multi-agent scenarios where each agent controls a mobile camera with a fixed angle of vision in the plane. The agents can thus observe their surroundings and each other. They can also reason about each other's observation abilities and knowledge derived from these observations. We introduce suitable logical languages for describing such scenarios, which involve atomic formulae stating what agents can see, multi-agent epistemic operators for individual, distributed and common knowledge, as well as dynamic operators reflecting the ability of cameras to move around in order to reach positions satisfying requirements specified by formulae. We introduce different versions of the semantics for these languages, discuss their expressiveness and provide translations to PDL style languages. Using these translations we develop algorithms and obtain complexity results for model checking and satisfiability testing for some extensions of the basic logic BBL introduced in [1]. We also discuss the interaction between knowledge and vision and, in particular, the dependence of the validities of our logic on the maximal admissible angles of vision of the agents' cameras. Finally, we discuss some further extensions, viz. adding obstacles or positioning the cameras in 3D. Besides being of purely logical interest, our work has potential applications to automated reasoning, formal specification and verification of observational abilities and knowledge of multi-robot systems.

[1] O. Gasquet, V. Goranko, and F. Scharzentruber, *Big brother logic: Logical modeling and reasoning about agents equipped with surveillance cameras in the plane*, ***Proceedings of AAMAS'2014***, IFAAMAS publ., 2014, pp. 325–332.

CONTRIBUTED TALKS 16

Wednesday, 5 August • 4.00PM-6.00PM
Venue - P722

▸ ALEXANDRA A. SOSKOVA, STEFAN V. VATEV, *Jump inversion for structures in the context of enumeration and ω-enumeration reducibilities.*
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We say that the set A is enumeration reducible to the set B if there is a c.e. set W_a such that $x \in A$ iff $(\exists v)[(x,v) \in W_a \;\&\; D_v \subseteq B]$, where D_v is the finite set with canonical index v. In this case we write $A = W_a(B)$.

Recall the following characterization of enumeration reducibility between sets A and B, $A \leq_e B$ iff $(\forall X \subseteq \mathbb{N})[B \leq_{c.e.} X \;\Rightarrow\; A \leq_{c.e.} X]$. For an infinite sequence of sets $\mathscr{R} = (R_n)_{n\in\omega}$ and a set X, we write $\mathscr{R} \leq_{c.e.} X$ if for every n, R_n is $\Sigma^0_{n+1}(X)$, uniformly in n. Soskov [4] considered the following reducibility between sequences of sets: $\mathscr{R} \leq_\omega \mathscr{P}$ iff $(\forall X \subseteq \mathbb{N})[\mathscr{P} \leq_{c.e.} X \;\Rightarrow\; \mathscr{R} \leq_{c.e.} X]$. This reducibility naturally induces an equivalence relation, whose equivalence classes are called ω-enumeration degrees. They form an upper semi-lattice, which have been extensively studied by a number of researchers at Sofia University over the past decade.

For a sequence of relations $\mathscr{R} = (R_n)_{n\in\omega}$ and a structure $\mathcal{A}$, we say that $\mathscr{R}$ is *relatively intrinsically c.e.* in $\mathcal{A}$ iff for all copies $(\mathcal{B}, \mathscr{Q})$ of $(\mathcal{A}, \mathscr{R})$, the sequence of sets $\mathscr{Q}$ is c.e. in the atomic diagram of $\mathcal{B}$, considered as a set. For a sequence of relations $\mathscr{R} = (R_n)_{n\in\omega}$ and a sequence of structures $\mathscr{A} = (\mathcal{A}_n)_{n\in\omega}$, we say that $\mathscr{R}$ is *relatively intrinsically ω-reducible* in $\mathscr{A}$ iff for all copies $(\mathscr{B}, \mathscr{Q})$ of $(\mathscr{A}, \mathscr{R})$, the sequence $\mathscr{Q}$ is ω-reducible to the sequence of atomic diagrams of $\mathscr{B}$.

In this talk we will concentrate on the following theorem.

Theorem 1 (Soskov, [3]). *For every sequence $\mathscr{A}$ of structures, there is a structure $\mathcal{M}$ such that for every sequence of relations $\mathscr{R}$,*

$$\mathscr{R} \leq_\omega \mathscr{A} \text{ iff } \mathscr{R} \leq_{c.e.} \mathcal{M}.$$

The construction of $\mathcal{M}$ is based on the so-called Marker's extentions of relations, first defined in [2]. We investigate a different approach. For each n, we code the relations of the structures $\mathcal{A}_n$ by a sequence of pairs of structures $\mathcal{B}^n_0, \mathcal{B}^n_1$. This is based on a construction first studied by Ash and Knight [1]. We finish by discussing what kind of properties are necessary for the structures $(\mathcal{B}^n_0, \mathcal{B}^n_1)_{n\in\omega}$ so that we can obtain Soskov's result.

[1] Chris Ash, Julia Knight, *Pairs of recursive structures*, ***Annals of Pure and Applied Logic***, vol. 46, (1990), pp. 211–234.

[2] Sergey Concharov, Bakhadir Khoussainov, *Complexity of categorical theories with computable models*, ***Algebra and Logic***, vol. 43 (2004), no. 6, pp. 365–374.

[3] Ivan N. Soskov, *Effective properties of Marker's extensions*, ***Journal of Logic and Computation***, vol. 23 (2013), no. 6, pp. 1335–1367.

[4] Ivan N. Soskov, *The ω-enumeration degrees*, ***Journal of Logic and Computation***, vol. 17 (2007), pp. 1193–1217.

VALENTINA HARIZANOV, *Complexity of orders on groups.*
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Orders on algebraic structures have been studied since Dedekind, Hölder, and Hilbert. In the last decade, the theory of orders on groups has become an important tool in understanding the geometric properties of 3-dimensional manifolds. We investigate computability-theoretic complexity of left orders and bi-orders on computable groups.

A *left order* on a group is a linear order of the elements of its domain, which is left-invariant with respect to the group operation. A right order is defined similarly. A left-orderable group is right-orderable and *vice versa*. A *bi-order* is both a left order and a right order. Every left-orderable group is torsion-free. There is a natural topology on the set of all left orders or bi-orders, even on an orderable structure with a single binary operation without any additional axioms (called magma). These spaces of orders are compact for any orderable magma, while for some well-known groups they are even homeomorphic to the Cantor set.

We investigate *truth-table degrees*, a refinement of Turing degrees, of orders on computable orderable groups. A computable orderable group may not have a computable order. We give a general sufficient condition for a computable group to admit a bi-order in every truth-table degree and apply this result to groups from various natural classes of finitely presented groups, including surface groups. This is joint work with J. Chubb and M. Dabkowski.

▸ JACOB SUGGS, *Lowness for isomorphism as restricted to classes of structures.*
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A degree is said to be low for isomorphism if whenever it computes an isomorphism between any pair of computable structures, there is also a computable isomorphism between those two structures. We can restrict this notion to consider only structures in certain classes or subclasses of structures. We find several results concerning which degrees are low for isomorphism as restricted to various classes of structures.

Classes under consideration include various subclasses of equivalence structures, scattered linear orders, and shuffle sums (a type of non-scattered linear order). For some subclasses, we are able to present a complete categorization of which degrees are low for isomorphism as restricted to that subclass. We also note the beginnings of a natural pattern relating the complexity of the degrees that are not low for isomorphism as restricted to a class of structures and the broad properties of that class.

▸ JENNIFER CHUBB, MIECZYSLAW DABKOWSKI, VALENTINA HARIZANOV, *Algorithmic complexity of orders of groups.*
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A group is called computable if membership in the structure (as a set) can be effectively determined and there is an effective algorithm for computing the group operation. An ordering of the elements of a group is called a bi-ordering if it is invariant under the left and right actions of the group on itself. We consider the algorithmic complexity of bi-orderings admitted by a large class of residually nilpotent groups.

▸ SVETLANA ALEKSANDROVA, NIKOLAY BAZHENOV, *Local computability and hereditarily finite superstructures.*
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The notion of local computability was introduced in [1] as an analogue for computable presentability for uncountable structures. On the other hand, there is a known approach to describing computability in uncountable structures via $\Sigma-$definability in hereditarily finite superstructures [2]. In this talk we explore properties of local computability with respect to hereditarily finite superstructures. In particular, we establish the following.

THEOREM 1. *Let $\mathfrak{M}$ be a model of a $\forall-$axiomatizable theory in a finite language. The hereditarily finite superstructure $\mathbb{HF}(\mathfrak{M})$ is locally computable iff $\mathfrak{M}$ is locally computable and $\mathbb{HF}(\mathfrak{M})$ is perfectly locally computable iff $\mathfrak{M}$ is perfectly locally computable.*

We shall also discuss the notion of constructivizability from [2], examining its connections to perfect local computability.

[1] MILLER, R.G. ***Locally computable structures***, Cooper, B., Lowe, B., Sorbi, A. (eds.) CiE 2007. LNCS, vol. 4497, pp. 575584. Springer, Heidelberg, 2007.
[2] ERSHOV, YU. L., ***Definability and Computability***, Consultants Bureau, New York-London-Moscow, 1996.

▸ PAYAM SERAJI, *Generalizing Gödel's and Rosser's incompleteness theorems for non-recursively enumerable theories.*
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This is a joint work with SAEED SALEHI.

The first Incompleteness Theorem of Kurt Gödel is generalized to definable theories, which are not necessarily recursively enumerable, by introducing a syntactic-semantic notion that corresponds to Gödels notion of ω-consistency in an appropriate way. Our main result is:

THEOREM 1. *If T is a theory in the language of arithmetic such that the set of its axioms is definable by a Σ_{n+1} (Π_n, Δ_{n+1}) formula and $T + \Pi_n$-Th($\mathbb{N}$) is consistent, then there exists a Π_{n+1} formula which is independent from T.*

The above-mentioned syntactic-semantic notion for a theory T is "the consistency of $T + \Pi_n$-Th($\mathbb{N}$)" which is

1. equivalent to the simple consistency of T for $n = 0$, when T is Σ_1 complete (for example when T contains Robinson's Arithmetic);
2. equivalent to 1-consistency of T for $n = 1$, see [1], recall that 1-consistency is the same as ω-consistency restricted to bounded (Δ_0) formulas;
3. equivalent to the soundness of T for $n = \infty$ (which then becomes the consistency of T + Th($\mathbb{N}$) that is $T \subseteq$ Th($\mathbb{N}$) in other words).

We also show that Rosser's incompleteness theorem is optimal in a sense: on the one hand this theorem states that any consistent and recursively enumerable (equivalently, Σ_1 definable) theory cannot be complete, and on the other hand one cannot extend the theorem to even Π_1 definable theories (let alone Σ_n or Π_n definable theories for $n \geqslant 2$) because it can be proved that:

THEOREM 2. *There exists a consistent and complete arithmetical theory whose set of axioms is definable by a Π_1 formula.*

[1] D. ISAACSON, *Necessary and Sufficient Conditions for Undecidability of the Gödel Sentence and its Truth*, ***Logic, Mathematics, Philosophy: Vintage Enthusiasms. Essays in honour of John L. Bell***, D. DeVidi & M. Hallett & P. Clark (Eds.) Springer (2011) pages 135–152.

CONTRIBUTED TALKS 17

Wednesday, 5 August • 4.00PM-6.00PM
Venue - P723

▸ YAMALEEV MARS, *There are no minimal pairs in $L[\mathbf{d}]$*.
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Given 2-computably enumerable (2-c.e.) set D with an effective approximation $\{D_s\}_{s\in\omega}$ such that $|D_s - D_{s-1}| \leq 1$, we say that $L(D) = \{s : \exists\, x \in D_s - D\}$ is the Lachlan's set of D. The Turing degree of $L(D)$ doesn't depend on the approximation (e.g., see Ishmukhametov [1]), hence we call $\deg(L(D))$ the Lachlan's degree of D. Let $\mathbf{d}$ be a 2-c.e. Turing degree, we define $L[\mathbf{d}] = \{\deg(L(B)) : B$ is 2-c.e and $B \equiv_T D\}$, elements of $L[\mathbf{d}]$ we also call as Lachlan's degrees of $\mathbf{d}$. Clearly, elements of $L[\mathbf{d}]$ are c.e. degrees, moreover, for any $\mathbf{w} \in L[\mathbf{d}]$ we have $\mathbf{w} \leq \mathbf{d}$ and $\mathbf{d}$ is computably enumerable relative to $\mathbf{w}$.

In a joint work with Fang C., Liu J. and Wu G. we obtained the following results.

Theorem 1. *Given 2-c.e. sets $A, B \in \mathbf{d}$, there exists 2-c.e. set $D \in \mathbf{d}$ such that $L(D) \leq_T L(A), L(B)$.*

If $\mathbf{d}$ has a proper 2-c.e. degree then $L[\mathbf{d}]$ contains only nonzero elements. Hence, as a corollary of Theorem 1, it cannot contain a minimal pair. Note that, if $\mathbf{d}$ would have a c.e. degree then $L[\mathbf{d}] = [0, \mathbf{d}]$ and it could contain a minimal pair.

By induction on Theorem 1, we can see that any finite number of elements from $L[\mathbf{d}]$ have lower bound from $L[\mathbf{d}]$. However, for the case of whole $L[\mathbf{d}]$ we can prove

Theorem 2. *There exists a 2-c.e. degree $\mathbf{d}$ such that $L[\mathbf{d}]$ doesn't have a nonzero lower bound.*

Based on this, in the talk we will discuss possible approaches in distinguishing properly 2-c.e. degrees from c.e. degrees in the class of all 2-c.e. degrees. Also we will discuss a generalization of $L[\mathbf{d}]$ for the case of weak truth-table degrees, particularly we will show that a weak truth-table analogue of $L[\mathbf{d}]$ can contain a minimal pair, if $\mathbf{d}$ has a proper 2-c.e. degree.

The work is supported by The President grant of Russian Federation (project NSh-941.2014.1), by Russian Foundation for Basic Research (projects 14-01-31200, 15-01-08252), by Kazan Federal University and by the subsidy allocated to Kazan Federal University for the project part of the state assignment in the sphere of scientific activities.

[1] Ishmukhametov Sh., *On the predececcors of d.r.e. degrees*, ***Archive for Mathematical Logic***, vol. 38 (1999), pp. 373–386.

▸ MARAT FAIZRAHMANOV, *Universal enumerations of families and hyperimmunity.*
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Any mapping ν of $\mathcal{N}$ onto a countable family $\mathcal{F}$ is called a *numbering* of $\mathcal{F}$. A numbering $\nu : \mathcal{N} \to \mathcal{F}$ is *X-computable* if a set of pairs

$$G_\nu = \{(x, y) : y \in \nu(x)\}$$

is X-c.e. and is *universal* if for every X-computable numbering μ of the family $\mathcal{F}$ there is a computable function f such that $\mu = \nu f$.

RESULTS:

1. Let X be a hyperimmune set. A finite family of X-c.e. sets $\mathcal{F}$ has universal X-computable numbering iff $\bigcap \mathcal{F} \in \mathcal{F}$.
2. If a set X is hyperimmune-free then every finite family of X-c.e. sets has universal X-computable numbering.
3. If a set X is hyperimmune-free then every finite family of X-c.e. sets without least element under inclusion has universal non-precomplete X-computable numbering.
4. There is a hyperimmune set X and an X-computable family $\mathcal{F}$ with universal non-precomplete X-computable numbering.
5. Let X be a high set. Every universal X-computable numbering is precomplete.

This work was funded by the subsidy allocated to Kazan Federal University for the state assignment in the sphere of scientific activities, project no. 1.2045.2014.

▸ MARAT FAIZRAHMANOV, ISKANDER KALIMULLIN, *Degree spectra of n-families.*
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It was shown in [1] that the classes $\overline{\mathbf{Low}}_n$ of non-low$_n$ degrees $\mathbf{x}$, $\mathbf{x}^{(n)} > \mathbf{0}^{(n)}$, are degree spectra of algebraic structures. Using the same methods one can show that the classes $\mathbf{High}_n$ of high$_n$ degrees $\mathbf{x}$, $\mathbf{0}^{(n+1)} \leq \mathbf{x}^{(n)}$, also form degree spectra of algebraic structure. In the talk we will show how to obtain these spectra using a generalization of the notion of the family of sets.

By 0-*family* we mean a subset of ω. Every finite subset of ω is called a *finitary* 0-family. By *n-family*, $n > 0$, we mean a countable set of m-families, $m < n$. Every n-family of finitary m-families, $m < n$, is called *finitary*. The *degree spectrum* of an n-family is the collection of all Turing degrees $\mathbf{x}$ in which the n-family is uniformly enumerable.

Theorem 1. *Each of the classes $\overline{\mathbf{Low}}_{2n}$ and $\mathbf{High}_{2n+1}$ is a degree spectrum of a finitary $(n+1)$-family but is not a degree spectrum of any n-family.*

Theorem 2. *Each of the classes $\overline{\mathbf{Low}}_{2n+1}$ and $\mathbf{High}_{2n+2}$ is a degree spectrum of a $(n+1)$-family but is not a degree spectrum of any finitary $(n+1)$-family.*

The work is partially supported by RFBR grant 15-31-20607.

[1] Sergey Goncharov, Valentina Harizanov, Julia Knight, Charles McCoy, Russell Miller, Reed Solomon, "Enumerations in computable structure theory", *Annals of Pure and Applied Logic*, **136**:3 (2005), 219–246.

▸ DAMIR ZAINETDINOV, *On limitwise monotonic reducibility of sets and sequences.*
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In the talk we study limitwise monotonic functions, sets and properties of limitwise monotonic reducibility (*lm*-reducibility for short) between Σ^0_2-sets.

The notion of limitwise monotonic sequence was introduced in [1]. The basic results on limitwise monotonic functions and sets can be found in [2].

Definition: Let $\mathcal{A} = \{A_n\}_{n\in\mathbb{N}}$ and $\mathcal{B} = \{B_n\}_{n\in\mathbb{N}}$ any arbitrary sequences of Σ^0_2-sets. Lets define the following families of the initial segments: $\mathcal{S}(\mathcal{A}) = \{\{n\} \oplus \mathbb{N} \upharpoonright a : a \in A_n,\ n \in \mathbb{N}\}$ and $\mathcal{S}(\mathcal{B}) = \{\{n\} \oplus \mathbb{N} \upharpoonright b : b \in B_n,\ n \in \mathbb{N}\}$. Then $\mathcal{A} \leq_{lm} \mathcal{B} \iff \mathcal{S}(\mathcal{A}) \leq_\Sigma \mathcal{S}(\mathcal{B})$, where definition of Σ-reducibility on the families can be found in [3].

Furthermore, we consider *lm*-reducibility between a given set and a pair of sets.

Theorem 1. *Let $\mathcal{C} = \{C_n\}_{n\in\mathbb{N}}$ be an arbitrary non-limitwise monotonic sequence of Σ^0_2-sets. There is a non-limitwise monotonic Σ^0_2-set A such that $\mathcal{C} \not\leq_{lm} A$.*

Theorem 2. *Let $\mathcal{A} = \{A_n\}_{n\in\mathbb{N}}$ be an arbitrary sequence of Σ^0_2-sets. There is a Σ^0_2-set B such that $B \not\leq_{lm} \mathcal{A}$.*

The research is partially supported by the RFBR, projects 14-01-31200, 15-31-20607.

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[2] Downey R., Kach A., Turetsky D., *Limitwise monotonic functions and their applications*, ***Proceedings of the Eleventh Annual Asian Logic Conference, World Sci. Publ., Hackensack, NJ***, (2012), pp. 59–85.

[3] Kalimullin I., Puzarenko V., *Reducibility on families*, ***Algebra and Logic***, vol. 48 (2009), no. 1, pp. 20–32.

▸ ANDREY SARIEV, *Definability in the local theory of the structure of the ω-Turing degrees*.
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In this paper we find a first order formula which defines the class of the intermediate degrees in the local substructure of the ω-Turing degrees.

[1] I.N. Soskov, *The ω-enumeration degrees*, ***Journal of Logic and Computation***, to appear.

[2] A. Sariev, H. Ganchev, *The ω-Turing degrees*, ***Annals of Pure and Applied Logic***, to appear.

▸ DARIUSZ KALOCIŃSKI, *Hierarchies of n-r.e. sets in every non-zero r.e. degree*.
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The result of Cooper-Epstein-Lachlan (see Appendix 2 in [1]) says there is a 2-r.e. degree which is not 1-r.e. This construction may be generalized: for any $n > 0$, there is $(n+1)$-r.e. degree which is not n-r.e. In a way, the greater the number of mind-changes allowed, the more Turing degrees we are able to produce. We go in an opposite direction and show that every non-zero r.e. degree contains a hierarchy of n-r.e. sets. To prove it, we use a combination of diagonalization and permitting (see [2]).

[1] Richard L. Epstein, ***Degrees of unsolvability: structure and theory***, Lecture Notes in Mathematics, Springer Berlin Heidelberg, 1979.

[2] Russel Miller, *Δ^0_2-spectrum of a linear order*, ***Journal of Symbolic Logic***, vol. 66 (2001), no. 2, pp. 470–486.

CONTRIBUTED TALKS 18

Friday, 7 August • 4.00PM–6.00PM
Venue – PI

▸ TIBOR BEKE, JIŘÍ ROSICKÝ, *Cellular objects and Shelah's singular compactness theorem*.
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The best-known version of Shelah's celebrated singular cardinal compactness theorem states that if the cardinality of an abelian group is singular, and all its subgroups of lesser cardinality are free, then the group itself is free. The proof can be adapted to cover a number of analogous situations in the setting of non-abelian groups, modules, graph colorings, set transversals etc. We give a single, structural statement of singular compactness that covers all examples in the literature that we are aware of. A case of this formulation, singular compactness for cellular structures, is of special interest; it expresses a relative notion of freeness. The proof of our functorial formulation is motivated by a paper of Hodges, based on a talk of Shelah. The cellular formulation is new, and related to recent work in abstract homotopy theory.

[1] T. Beke and J. Rosický, *Abstract elementary classes and accessible categories*, Annals Pure Appl. Logic 163 (2012), 2008–2017

[2] P. C. Eklof, *Shelah's singular compactness theorem*, Publ. Math. 52 (2008), 3–18

[3] P. C. Eklof and A. M. Mekler, *Almost Free Modules*, North-Holland 1990

[4] P. S. Hirschhorn, *Model categories and their localizations.* Mathematical Surveys and Monographs, 99. American Mathematical Society, Providence, RI, 2003

[5] W. Hodges, *In singular cardinality, locally free algebras are free*, Alg. Univ. 12 (1981), 205–220

[6] J. Lurie, *Higher Topos Theory*, Princeton Univ. Press 2009

[7] M. Makkai and R. Paré, *Accessible categories: The Foundation of Categorical Model Theory*, Cont. Math. 104, AMS 1989.

[8] M. Makkai, J. Rosický and L. Vokřínek, *On a fat small object argument*, Advances in Math. 254 (2014), 49–68

[9] S. Shelah, *A compactness theorem for singular cardinals, free algebras, Whitehead problem and transversals*, Israel J. Math. 21 (1975), 319–349

▸ JUAN A. NIDO, GABRIEL SALAZAR, LUIS M. VILLEGAS, *Locally projective modules and large cardinals*.
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In this talk I will present the main results of the recent work [6] of the authors, in which the class of locally projective modules is studied from an algebraic, a model theoretic and a large cardinal point of view. In this work, we introduced the class of κ-locally projective modules over various classes of rings. These are modules whose "most" submodules of cardinality $< \kappa$ are locally projective. I will mention some positive results with respect to compactness when κ is a singular, a subtle (under $V = L$) or a weakly compact cardinal, where the proof for subtle cardinals requires the construction in L of some elementary embeddings. Finally, I will present a similar result for ultraproducts of locally projective modules when the index set is a measurable cardinal.

[1] P. C. Eklof, A. H. Mekler, ***Almost Free Modules. Set-theoretic Methods. Revised Edition***, North-Holland Mathematical Library, North Holland, 2002.

[2] R. Göbel, J. Trlifaj, ***Approximations and Endomorphism Algebras of Modules, Vol.1 - Approximations***, Expositions in Mathematics, Walter de Gruyter, 2nd Edition, 2013.

[3] R. B. Jensen, *The Fine Structure of the Constructible Hierarchy*, ***Annals of Mathematical Logic***, vol. 4 (1972), no. 3, pp. 229–308.

[4] A. Kanamori, ***The Higher Infinite. Large Cardinals in Set Theory from Their Beginnings***, Springer Monographs in Mathematics, Springer-Verlag, 2nd Edition, 2009.

[5] P. Mendoza, J. A. Nido Valencia, L. M. Villegas Silva, *Weakly Compact Cardinals and κ-torsionless Modules*, ***Revista Colombiana de Matemáticas***, vol. 43 (2010), no. 2, pp. 139–163.

[6] J. A. Nido Valencia, H. G. Salazar Pedroza, L. M. Villegas Silva, *Locally Projective Modules and Large Cardinals*, ***Preprint***.

▸ TOMASZ RZEPECKI, *Topological dynamics and invariant equivalence relations.*
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I will present methods (under development with Krupiński and Pillay) which, using topological dynamics (in the spirit of [4]), allow us to deduce various properties of strong type spaces from facts about compact groups.

In particular, they allow us to generalise several important results from [2] and [3] concerning connections between number of classes, Borel cardinality and definability of such relations. One of the main results is that (when the language is countable) for a bounded Borel (invariant) equivalence relation E on (the set of realisations of) a single complete type, E is smooth if and only if it is type-definable. This was previously shown for Lascar strong types ([1]) and for some F_σ equivalence relations ([2] and independently [3]), but the previous methods seemed incapable of reaching the result in the current generality.

We also obtain a similar result even for uncountable languages: for a large class of invariant relations on a single type, we have that the relation (or even its restriction to e.g. a KP strong type) either is relatively definable or it has at least $2^{\aleph_0}$ classes.

[1] Itay Kaplan, Benjamin Miller, Pierre Simon, *The Borel cardinality of Lascar strong types*, ***Journal of the London Mathematical Society***, vol. 90 (2014), no. 2, pp. 609–630.

[2] Itay Kaplan, Benjamin Miller, *An embedding theorem of E_0 with model theoretic applications*, ***Journal of Mathematical Logic***, vol. 14 (2014), no. 2

[3] Krzysztof Krupiński, Tomasz Rzepecki, *Smoothness of bounded invariant equivalence relations*, ***Journal of Symbolic Logic***, accepted.

[4] Krzysztof Krupiński, Anand Pillay, *Generalized Bohr compactification and model-theoretic connected components*, submitted.

▸ PEDRO ZAMBRANO, *Around the set-theoretical consistency of d-tameness of metric abstract elementary classes.*
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W. Boney proved that under the existence of a strongly compact cardinal κ, any Abstract Elementary Class (AEC) essentially below κ (i.e., controlled in some way by $L_{\kappa\omega}$) is tame, setting where the Shelah's categoricity transfer conjecture holds. M. Lieberman and J. Rosicky proved a similar result in accessible categories, which corresponds to a categorial generalization of both discrete AECs and Metric AECs (MAECs). However, their arguments are still discrete. P. Zambrano studied a metric version of tameness which is enough to prove a stability transfer theorem in MAECs, in a similar way as J. Baldwin, D. Kueker and M. VanDieren did in tame discrete AECs. In this talk, we will talk about a preliminary study of the set-theoretical consistency of the metric version of tameness in MAECs. This is a joint work with Will Boney.

▸ GÁBOR SÁGI, *On weakly generic automorphisms of homogeneous structures.*
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A relational structure $\mathcal{A}$ with a countable universe is defined to be homogeneous iff every finite partial isomorphism of $\mathcal{A}$ can be extended to an automorphism of $\mathcal{A}$. The structure $\mathcal{A}$ may be endowed with the discrete topology, then the automorphism group of $\mathcal{A}$ becomes a topological group (with the suitable topological power of the discrete topology on $\mathcal{A}$).

An automorphism of $\mathcal{A}$ is defined to be weakly generic iff its conjugacy class (in the group theoretic sense) is dense in the topologal sense. We will present sufficient conditions implying the existence of weakly generic automorphisms of certain homogeneous structures. Connections with finite combinatorics will also be discussed.

▸ MICHAEL LIEBERMAN, JIŘÍ ROSICKÝ, *Metric AECs as accessible categories.*
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We introduce a category-theoretic framework generalizing that pursued in [1], and ideally suited to the analysis of classes (like mAECs) in which directed colimits need not be concrete, but κ-directed colimits are concrete for some κ. We propose calling such categories κ-AECs, with mAECs, which are $\aleph_1$-AECs in this sense, as a prototypical example. Using results of [1], we immediately obtain, in [2], a categorical presentation theorem for mAECs, and deduce the existence of a robust (but fundamentally nonsyntactic) EM-functor. More importantly, a careful analysis of the arguments in that paper allows partial results to be shifted to this more general framework: as a consequence, we are able to prove the stability of mAECs in certain cardinals below a categoricity cardinal. In fact, this is the tip of the iceberg: analogous results hold for general κ-AECs.

[1] ——— *Classification theory for accessible categories*, to appear in the ***Journal of Symbolic Logic***

[2] ——— *Metric abstract elementary classes as accessible categories*, in preparation.

CONTRIBUTED TALKS 19

Friday, 7 August • 4.00PM–6.00PM
Venue - PII

▸ ERIK PALMGREN, *Some applications of dependently sorted logic in constructive mathematics*.
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Dependent families of sets often occur in mathematical notation, for instance as the fibers of a map $f : Y \to X$,

$$f^{-1}(x) \quad (x \in X)$$

$$\mathrm{inj}_x(u) \in Y \quad (x \in X, u \in f^{-1}(x))$$

or as the hom-sets of a category

$$\mathrm{Hom}(A, B) \quad (A, B \in \mathrm{Ob})$$

$$1_A \in \mathrm{Hom}(A, A) \quad (A \in \mathrm{Ob}).$$

Such expressions are however not directly supported in first-order logic, one usually formulate them in a roundabout way using set-valued functions as in set theory. Dependent type theory (Martin-Löf 1984) has built-in notation for such families, but the logic is given in a fixed way by the propositions-as-types principles. The so-called logic enriched type theories (Aczel 2004, Gambino and Aczel 2006) permit a more flexible interpretation of the logic. The dependent sorts or types are very natural in axiomatizing constructive mathematics in a first-order way. An important feature of this logic is the *local proposition-as-types principle*, which is enabled by the possibility to associate to any proposition a type of its proof objects. This allows for a smooth treatment of partial functions among other things.

A dependently typed or sorted system of first-order logic, FOLDS, was introduced and studied by Makkai (Makkai 1995, 2013). The purpose of FOLDS is to provide a natural foundation for (higher) category theory that can also serve as foundation of a theory abstract sets. Unlike set theory there is no global notion of equality in the system. When formalizing category theory in such systems one is thus not committed to introducing equality between objects. We consider here a system rather similar to FOLDS for dependently typed first-order logic, due to Belo (2008). It is based on the generalized algebraic theories of Cartmell 1986. A simplifying difference to Cartmell is that it is not considering equality of sorts or types, but in contrast to (Makkai 1995) it allows function symbols. The system may be regarded as a fairly natural extension of many sorted intuitionistic logic. Moreover an important property is that the system is straightforwardly interpretable in Martin-Löf type theory, and thus possible to use in connection with proof assistants such as Coq or Agda. We give some elementary proof theoretic properties of the system, and present some applications to the formalization of constructive mathematics.

[1] P. Aczel. *Predicate logic with dependent sorts or types.* Unpublished manuscript (2004)

[2] J.F. Belo. *Dependently Sorted Logic.* ***TYPES 2007*** (M. Miculan, I. Scagnetto, and F. Honsell, Editors): LNCS 4941, pp. 33 – 50, Springer 2008.

[3] J.F. Belo. *Foundations of Dependently Sorted Logic.* PhD Thesis, Manchester 2008.

[4] N. Gambino and P. Aczel. The generalized type-theoretic interpretation of constructive set theory. *Journal of Symbolic Logic* 71(2006), 67 – 103.

[5] J. Cartmell. Generalized algebraic theories and contextual categories. *Annals of Pure and Applied Logic,* 32(1986), 209 – 243.

[6] M. Makkai. First-order logic with dependent sorts, with applications to category theory. Preprint 1995, version November 6. 201 pp. Available from Makkai's webpages.

[7] M. Makkai. The theory of abstract sets based on first-order logic with dependent types. Preprint 2013. Available from Makkai's webpages.

▸ PATRICK WALSH, *Justifying path induction*.
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In their ongoing research into the applications of Homotopy Type Theory (HoTT), James Ladyman and Stuart Presnell have put forward concerns regarding HoTT's ability to serve as a foundations for mathematics. Their concerns stem from works like [1] and [2] in discussing foundational problems of mathematics and newer non-set-theoretic putative foundations. The authors claim that the identity rules in HoTT, as stated in the 'HoTT Book', are not sufficiently justified which is problematic for foundational concerns. Although the authors give their own justification for the rules, I find it insufficient and guided by inappropriate constraints. Their challenge is good; their own response is not. I give an argument against their constraint that a foundation has to be 'pre-mathematically' justified and suggest a better way for justifying the rules of HoTT. I argue that rules of inference can be justified without externalist or non-mathematical considerations and so I provide a *mathematical* justification of the identity rules of HoTT.

The main argument against the pre-mathematical justification requirement that Mayberry, Ladyman, and Presnell subscribe to is that it forces an overly close relationship between pre-theoretic and theoretic notions. Indeed, it seems their position entails that mathematics be largely a restatement of pre-theoretical notions, against all appearances. I suggest a mathematical justification based on categorical logic, specifically the work by Lawvere in *hyperdoctrines*.

[1] John Mayberry, *What is Required of a Foundation for Mathematics?*, ***Philosophia Mathematica***, vol. 2 (1994), no. 1, pp. 16–35.

[2] Øystein Linnebo, and Richard Pettigrew, *Category Theory as an Autonomous Foundation*, ***Philosophia Mathematica***, vol. 19 (2011), no. 3, pp. 227–254.

▸ FEDERICO MUNINI, FRANCO PARLAMENTO, *Admissiblility of the structural rules in Kanger's sequent calculus for first order logic with equality*.
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By Kanger's sequent calculus we mean the sequent calculus for classical first order logic with equality, free of structural rules, introduced in [2] for efficient proof search pourposes, to be denoted by $\mathbf{K}^=$. The semantic correctness and completeness of $\mathbf{K}^=$ make it straightforward that the cut rule is admissible in $\mathbf{K}^=$, as it was originally noticed by Kanger himself in [1] for the analogous system without equality. See also [3] for a recollection of Kanger's attitude toward the cut elimination theorem resulting from his almost trivial semantic proof. That straight classical semantic route is clearly not viable to establish the admissibility of the contraction rule nor, of course, to treat the intuitionistic version $\mathbf{KJ}^=$ of $\mathbf{K}^=$. Our pourpose is to provide a syntactic proof that the cut rule and the contraction rule, as well as the weakening and the exchange rules, are admissible both in $\mathbf{K}^=$ and $\mathbf{KJ}^=$. For the proof we will use the method introduced in [4]. More precisely we will derive the admissibility of the cut and the contraction rules in $\mathbf{K}^=$ and $\mathbf{KJ}^=$ from the admissibility in such systems of the natural deduction elimination rule for equality as formulated in the sequent calculus, namely of the following rule:

$$\frac{\Gamma \Rightarrow F\{v/r\} \qquad \Gamma \Rightarrow r = s}{\Gamma \Rightarrow F\{v/s\}}$$

where $F\{v/r\}$ ($F\{v/s\}$)) denotes the result of substituting all the free occurrences of v in F by r (by s).

[1] S. Kanger, ***Provability in Logic***, Acta Universitatis Stockholmensis, Stockolm studies in Philosophy I, Almqvist and Wiksell, Stockholm, 1957,

[2] ———, *A Simplified Proof Method for Elementary Logic*, ***Computer Programming and Formal Systems*** (P. Braffort and D. Hirshberg, editors), North-Holland, Amsterdam, 1963, pp. 87–94.

[3] D. Prawitz, *A Note on Kanger's Work on Efficient Proof Procedures*, ***Collected Papers of Stig Kanger with Essays on his Life and Work, Vol II*** (G. Holmström-Hintikka, S. Linström and R. Slivinski, editors), Kluwer Academic Publisher, Dordrecht, 2001, pp. 43–52.

[4] F. Parlamento and F. Previale, *Cut elimination for Gentzen's Sequent Calculus with Equality and Logic of Partial Terms*, ***Lecture Notes in Computer Science***, vol. 7750 (2013), pp. 161–172.

▸ TAISHI KURAHASHI, *Rosser-type Henkin sentences and local reflection principles.*
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Rosser-type Henkin sentences, that is, sentences asserting their own provability in the sense of Rosser were discussed by Halbach and Visser [3]. Rosser-type local reflection principles were investigated by Goryachev [1], where reflection principles are shchemata representing the soundness of a theory.

1. We give a necessary and sufficient condition that a sentence is a Rosser-type Henkin sentence of some Rosser's provability predicate, and prove that any negated Rosser sentence can be a Rosser-type Henkin sentence. 2. We prove the existence of a Rosser's predicate whose Rosser-type Henkin sentences are all provable or refutable. 3. We solve the question raised by Shavrukov [4], and give a Rosser's predicate whose local reflection principle is strictly weaker than the usual one. 4. We investigate the hierarchy of partial local reflection principles based on Rosser's predicates. We prove our results by using the technique of Guaspari and Solovay [2].

[1] Goryachev, S.V., *An arithmetic with a local reflection principle for the Rosser provability formula (in Russian)*, ***Mathematical notes of the Academy of Sciences of the USSR***, vol.46 (1989), no.3, 689–694.

[2] Guaspari, D. and Solovay, R.M., *Rosser sentences*, ***Annals of Mathematical Logic***, vol.16 (1979), no.1, pp.81–99.

[3] Halbach, V. and Visser A., *Self-reference in arithmetic II*, ***The Review of Symbolic Logic***, vol.7 (2014), no.4, pp.692–712.

[4] Shavrukov, V.Y., *On Rosser's provability predicate*, ***Zeitschrift für Mathematische Logik und Grundlagen der Mathematik***, vol. 37 (1991), no.4, pp.317–330.

CONTRIBUTED TALKS – FRIDAY 7 AUGUST

▸ MAJID ALIZADEH, FARZANEH DERAKHSHAN, HIROAKIRA ONO, *Uniform interpolation in weak Grzegorczyk logic and Gödel-Löb logic.*
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A given logic **L** has Craig interpolation property if and only if for any formula α and β, if $\alpha \to \beta$ is provable in **L** then there exists a formula γ such that both $\alpha \to \gamma$ and $\gamma \to \beta$ are provable in **L** and moreover $V(\gamma) \subseteq V(\alpha) \cap V(\beta)$ holds. Here $V(\phi)$ denotes the set of all propositional variables in a given formula ϕ. Such a formula γ is called an *interpolant* of the formula $\alpha \to \beta$. An interpolant of a given formula $\alpha \to \beta$ is not always determined uniquely, and depends on both of formulas α and β in general. *Uniform interpolation property* is a stronger form of Craig interpolation property which assures the existence of the *post-interpolant* which is determined only by α and the *pre-interpolant* which is determined only by β.

It is easy to show that classical propositional logic has uniform interpolation property. But to show it for intuitionistic propositional logic was not trivial. This was shown first by using proof theoretic way in [P92] and then semantically in [GZ95a, V96]. It should remarked here that uniform interpolation property does not hold for classical predicate logic (shown in [H63]), and neither for intuitionistic predicate logic. There exist also modal propositional logics, for example $\mathbf{S_4}$, which have Craig's interpolation property but do not have uniform interpolation property [GZ95b].

In the present paper which is a continuation of our work on uniform interpolation for substructural logics [ADO], we will discuss uniform interpolation property of weak Grzegorczyk logic **Go** and Gödel-Löb logic **GL**, using the proof theoretic method introduced by Pitts [P92]. To apply the method, it is necessary to formalize a logic under consideration in a cut-free sequent calculus. In [RGR] such a calculus was presented for **Go**. A key proposition of [P92] can be shown by the induction of the *weight* of formulas and *backward proof searches*, where the weight of a formula means roughly its complexity. A main obstacle in this argument will be caused by any rule such that the weight of its upper sequent(s) is not smaller than that of the lower sequent. Typically, this can be caused by contraction rules. To resolve this difficulty, Pitts [P92] employed a contraction- free sequent calculus for intuitionistic propositional logic introduced by [D92] and [HJ89], instead of the original Gentzens calculus **LJ**. Here a contraction-free calculus means that it does not contain usual contraction rule(s) explicitly. Similarly, B ́lková [B07] introduced contraction-free calculi for modal propositional logics **K** and **T**, to show uniform interpolation property of them. She also proved, in her Phd thesis by proof theoretical way, that the Gödel-Löb logic has the uniform interpolation.

From these observations, we can expect that uniform interpolation property will hold for weak Grzegorczyk logic without contraction rules.

Theorem 1. *Uniform interpolation property holds for weak Grzegorczyk logic.*

To prove this we first introduce an equivalent contraction-free calculus GoS^* for weak Grzegorczyk logic. Then for any non-negative integer n, we introduce a formula $A^n_p(\Gamma;\Delta)$ (see tables 1 and 2 below) where p is any propositional variable and Γ and Δ are multiset of formulas, following the idea by Pitts, and show a key lemma for them as we state in the following.

LEMMA 2. *For any pair* Γ *and* Δ *of multisets of formulas, and any propositional variable p, the following statements hold:*

1. $V(A^i_p(\Gamma;\Delta)) \subseteq V(\Gamma,\Delta)\backslash\{p\}$ *for every* $i \geq 0$.
2. $\Gamma, A^i_p(\Gamma;\Delta) \Rightarrow \Delta$ *is provable in* Gos^* *for every* $i \geq 0$
3. *Let* Π *and* Λ *be any multisets of formulas not containing p. If* $\Pi,\Gamma \Rightarrow \Delta,\Lambda$ *is provable in* GoS^* *by using GoR rule at most j times, then* $\Pi \Rightarrow A^j_p(\Gamma;\Delta),\Lambda$ *is provable in* GoS^*.

TABLE 1. Definition of $A^0_p(\Gamma;\Delta)$ for GoS^*

$\Gamma;\Delta$ matches	$\mathcal{A}^0_p(\Gamma;\Delta)$ contains
$\emptyset;\emptyset$	$\bot$
$\emptyset;q$	q
$q;\emptyset$	$\neg q$
$r;r$	$\top$
$\Gamma;\top,\Delta'$	$\top$
$\Gamma',\bot;\Delta$	$\top$
$\Gamma',\varphi\wedge\psi;\Delta$	$A^0_p(\Gamma',\varphi,\psi;\Delta)$
$\Gamma',\varphi\vee\psi;\Delta$	$A^0_p(\Gamma',\varphi;\Delta)\wedge A^0_p(\Gamma',\psi;\Delta)$
$\Gamma',\varphi\to\psi;\Delta$	$A^0_p(\Gamma';\varphi,\Delta)\wedge A^0_p(\Gamma',\psi;\Delta)$
$\Gamma;\varphi\wedge\psi,\Delta'$	$A^0_p(\Gamma;\varphi,\Delta')\wedge A^0_p(\Gamma;\psi,\Delta')$
$\Gamma;\varphi\vee\psi,\Delta'$	$A^0_p(\Gamma;\varphi,\psi,\Delta')$
$\Gamma;\varphi\to\psi,\Delta'$	$A^0_p(\Gamma,\varphi;\psi,\Delta')$
$\Gamma',\varphi;\Delta$	$A^0_p(\Gamma';\Delta)$, where φ is a non-boxed formula
$\Box\Gamma';\Box A$	$\Box A^0_p(\Gamma',\Box\Gamma',\Box(A\to\Box A);A)$
otherwise	$\bot$

Remark. Since the difference between Godel-Lob's logic and weak Grzegorczyk logic lies in their modal rule, to get the similar result in **GL** it is sufficient to capture this rule in the definition of A^i_p. By changing the 3rd row from the last in the A^n_p table and some slight modifications in definitions, one could do so. However, to prove the uniform interpolation for **GL** we face the similar difficulty as in weak Grzegorczyk logic, i.e., the weight $w(\Box\Gamma',\Gamma';\emptyset)$ is not necessarily strictly less than $w(\Box\Gamma';\emptyset)$. In fact, the superscript i in the definiton of A^i_p is introduced in order to overcome this difficulty. With this superscript we can use an induction on the lexicographical pair $< i, Weight >$ to prove the uniform interpolation property. Bílková provides another approach to overcome this problem for GL in her thesis . Not only the results of our approach give a more simple and natural proof for uniform interpolation in Gl but also, A^i_p algorithmically tracks the proof search tree backward until encounters a GoR rule in which Δ is empty, in this case it jumps from A^i_p to A^{i-1}_p. As a consequence we have a better understanding of both the structure of proofs in GL and the uniform interpolation property.

TABLE 2. Definition of $A^n_p(\Gamma;\Delta)$ for GoS^*

$\Gamma;\Delta$ matches	$\mathcal{A}^n_p(\Gamma;\Delta)$ contains
$\emptyset;\emptyset$	$\bot$
$\emptyset;q$	q
$q;\emptyset$	$\neg q$
$r;r$	$\top$
$\Gamma;\top,\Delta'$	$\top$
$\Gamma',\bot;\Delta$	$\top$
$\Gamma',\varphi\wedge\psi;\Delta$	$A^n_p(\Gamma',\varphi,\psi;\Delta)$
$\Gamma',\varphi\vee\psi;\Delta$	$A^n_p(\Gamma',\varphi;\Delta)\wedge A^n_p(\Gamma',\psi;\Delta)$
$\Gamma',\varphi\to\psi;\Delta$	$A^n_p(\Gamma';\varphi,\Delta)\wedge A^n_p(\Gamma',\psi;\Delta)$
$\Gamma;\varphi\wedge\psi,\Delta'$	$A^n_p(\Gamma;\varphi,\Delta')\wedge A^n_p(\Gamma;\psi,\Delta')$
$\Gamma;\varphi\vee\psi,\Delta'$	$A^n_p(\Gamma;\varphi,\psi,\Delta')$
$\Gamma;\varphi\to\psi,\Delta'$	$A^n_p(\Gamma,\varphi;\psi,\Delta')$
$\Gamma',\varphi;\Delta$	$A^n_p(\Gamma';\Delta)$, where φ is a non-boxed formula
$\Box\Gamma';\Box A$	$\Box A^n_p(\Gamma',\Box\Gamma',\Box(A\to\Box A);A)$
$\Box\Gamma';\emptyset$	$\neg\Box\neg A^{n-1}_p(\Box\Gamma',\Gamma';\emptyset)$
otherwise	$\bot$

[ADO]M. ALIZADEH, F. DERAKHSHAN AND H. ONO, *Uniform Interpolation in Substructural Logics*, ***the Review of Symbolic Logic***, 7 (2014) 455-483.

[B07]M. BÍLKOVÁ, *Uniform interpolation and propositional quantifiers in modal logics*, ***Studia Logica***, 85 (2007) 1-31.

[D92]R. DYCKHOFF, *Contraction-free sequent calculi for intuitionistic logic*, ***Journal of Symbolic Logic***, 78 (1992) 795-807.

[GZ95a]S. GHILARDI AND M. ZAWADOWSKI, *A sheaf representation and duality for finitely presented Heyting algebras*, ***Journal of Symbolic Logic***, 60 (1995) 911-939.

[GZ95b]S. GHILARDI AND M. ZAWADOWSKI, *Undefinability of propositional quantifiers in the modal system S4*, ***Studia Logica***, 55 (1995) 259-271.

[RGR]R. GORÉ AND R. RAMANAYAKE, *Cut-elimination for Weak Grzegorczyk Logic* G_o, ***Studia Logica***, 102 (2014), 1-27.

[H63]L. HENKIN, *An extension of the Craig-Lyndon interpolation theorem*, ***Journal of Symbolic Logic*** ,28 (1963) 201-216.

[HJ89]J. HUDELMAIER, *Bounds for cut elimination in intuitionistic propositional logic*, Ph.D. Thesis, University of Tübingen, 1989.

[P92]A.M. PITTS, *On an interpretation of second order quantification in first order intuitionistic propositional logic*, ***Journal of Symbolic Logic***, 57 (1992) 33-52.

[V96]A. VISSER, *Uniform interpolation and layered bisimulation*, in: P. Hájek ed., LECTURE NOTES IN LOGIC 6 GÖDEL '96: LOGICAL FOUNDATIONS OF MATHEMATICS, COMPUTER SCIENCE AND PHYSICS — KURT GÖDEL'S LEGACY, Springer (1996) 139-164.

▶ WALTER DEAN,HIDENORI KUROKAWA, *A simplification of the Theory of Construction*.
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This paper extends the program described in [1] for simplifying and rehabilitating the *Theory of Constructions* $\mathcal{T}$ proposed by Kreisel [4] and Goodman [3]. Kreisel explained his goal in formulating $\mathcal{T}$ as that of setting up "*a formal system ... in terms of which the rules of Heyting's predicate calculus can be interpreted*". Kreisel's formulation was based on the untyped lambda calculus together with a term forming operator π such that πxy is intended to express "construction y proves x".

Kreisel defined a predicate $\Pi(A, t)$ inductively in terms of a formula A with the intended interpretation "the construction t gives the proof conditions of A" (understood according to Kreisel's *second clause* variant of the BHK interpretation). Kreisel aimed to show the soundness and faithfulness of $\mathcal{T}$ in the form

$$\mathsf{HPC} \vdash A \text{ if and only if } \mathcal{T} \vdash \Pi(A, t) \equiv \top \text{ for some term } t$$

However, only a sketch of the soundness proof is presented by Kreisel whereas Goodman's faithfulness proof is for a more intricate "stratified" theory.

We will describe a variant $\mathcal{T}_0$ of Kreisel's system modified by omitting a form of reflection principle to avoid a paradox discovered by Goodman. We will show that $\mathcal{T}_0$ avoids the paradox discovered by Goodman, and also that this system is still sufficient for interpreting HPC. We will additionally describe a strategy for proving faithfulness via the use of a modified form of Laüchli realizability employing techniques from Fitting's [2] completeness proof for the first-order Logic of Proofs (thereby avoiding the arithmetical interpretation employed by Goodman).

[1] W. Dean and H. Kurokawa, *Kreisel's Theory of Constructions, the Kreisel-Goodman paradox, and the second clause* , ***Advances in Proof-Theoretic Semantics*** (T. Piecha and P. Schroeder-Heister, editors), Springer, 2015.

[2] M. Fitting, *Annals of Pure and Applied Logic*, ***Possible world semantics for first-order logic of proofs***, vol. 165 (2014), no.1, pp. 225–240.

[3] N. Goodman, *A Theory of Constructions Equivalent to Arithmetic*, ***Intuitionism and Proof Theory*** (A. Kino, J. Myhill and R.E. Vesley), Elsevier, 1970.

[4] G. Kreisel, *Foundations of intuitionistic logic*, ***Studies in Logic and the Foundations of Mathematics*** Elsevier, 1962.

CONTRIBUTED TALKS 20

Friday, 7 August • 4.00PM–6.00PM
Venue - PIII

▶ DOROTTYA SZIRÁKI, JOUKO VÄÄNÄNEN, *A dichotomy theorem for the generalized Baire space and elementary embeddability at uncountable cardinals*.
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We consider the following generalization to uncountable cardinals κ of a dichotomy theorem [1, 2] for Σ^0_2 binary relations on Polish spaces: if R is a $\Sigma^0_2(\kappa)$ binary relation on an analytic subset of the κ-Baire space, then either all R-independent sets are of size at most κ, or there is a κ-perfect R-independent set. We prove that the above statement holds under the set theoretic hypothesis $\mathrm{I}^-(\kappa)$ when κ is inaccessible, and under $\mathrm{I}^-(\kappa)$ and $\diamondsuit_\kappa$ when κ is arbitrary. The hypothesis $\mathrm{I}^-(\kappa)$ is a modification of the hypothesis $\mathrm{I}(\kappa)$ found in literature and states: there exists a κ^+-complete normal ideal $\mathcal{I}$ on κ^+ and a dense subset $K \subseteq \mathcal{I}^+$ in which every descending sequence of length $< \kappa$ has a lower bound.

We obtain as a corollary a dichotomy about the set of κ-sized models of an $L_{\kappa^+\kappa}$-sentence when considered up to isomorphism, or embeddability, by elements of a K_κ subset of ${}^\kappa\kappa$ (i.e. a union of κ many κ-compact subsets of ${}^\kappa\kappa$). The role of embeddings can be replaced by that of elementary embeddings or functions preserving certain subsets of $L_{\kappa^+\kappa}$; these subsets include the logics $L_{\lambda\mu}$ for $\omega \leq \mu \leq \lambda \leq \kappa$ and their finite variable fragments $L^n_{\lambda\mu}$ $(n < \omega)$.

[1] W. Kubis, *Perfect cliques and G_δ colorings of Polish spaces*, ***Proceedings of the American Mathematical Society***, vol. 131 (2003), no. 2, pp. 619–623.

[2] S. Shelah, *Borel sets with large squares*, ***Fundamenta Mathematicae***, vol. 159 (1999), no. 1, pp. 1–50.

▶ KEVIN FOURNIER, *Wadge hierarchy of differences of coanalytic sets*.
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Collections of substets of the Baire space, the "logician's reals", that are closed under continuous preimages have always been ubiquitous in descriptive set theory. It is thus quite remarkable to realize that the concept of *pointclass* has not been singled out and studied for itself before the 1960's and the work of Wadge. In his PhD Thesis ([5]), he was the first to study systematically the concept, via the notion of continuous reducibility. He proved in particular that all the non self-dual Borel pointclasses can be obtained by ω-ary Borel boolean operations on open sets. Following Wadge, Louveau provided in [3] a description of all the Borel pointclasses, and thus of the whole Wadge hierarchy on the Borel sets, by means of boolean operations.

Working in $ZFC + \mathrm{DET}(\underset{\sim}{\boldsymbol{\Pi}}^1_1)$, we show how to extend the constructions of Louveau on the Borel sets to $\mathrm{Diff}(\underset{\sim}{\boldsymbol{\Pi}}^1_1)$, the class of increasing differences of coanalytic subsets. This extension provides a complete description of the pointlcasses included in $\mathrm{Diff}(\underset{\sim}{\boldsymbol{\Pi}}^1_1)$. Surprisingly enough, the set of operations used in the Borel case is sufficient for this task, we so to speak only add the possibility for them to act on $\underset{\sim}{\boldsymbol{\Pi}}^1_1$ sets. We also investigate the discreapancy between the pointclasses of differences using *increasing* sequences of $\underset{\sim}{\boldsymbol{\Pi}}^1_1$ sets, and differences using *decreasing* sequences of $\underset{\sim}{\boldsymbol{\Pi}}^1_1$ sets. We prove, by combining our analysis with results from Martin [4] and Harrington [2], that our determinacy hypothesis is optimal. These results will appear in an article by the author [1].

[1] Kevin Fournier, *Wadge hierarchy of differences of coanalytic sets*, ***Journal of Symbolic Logic***, Accepted for publication.

[2] Leo A. Harrington, *Analytic determinacy and $0^{\#}$*, ***The Journal of Symbolic Logic***, vol. 43 (1978), no. 4, pp. 685–693.

[3] Alain Louveau, *Some Results in the Wadge hierarchy of Borel sets*, ***Wadge Degrees and Projective Ordinals: The Cabal Seminar, Volume II*** (Alexander S. Kechris, Benedikt Löwe, and John R. Steel, editors), Cambridge University Press, 2012, pp. 47–63.

[4] Donald A. Martin, *Measurable cardinals and analytic games*, ***Fundamenta Mathematicae***, vol. 66 (1970), pp. 287–291.

[5] William W. Wadge, *Reducibility and determinateness on the Baire space*, PhD. Thesis, University of California, Berkeley, 1984.

▸ PETER SCHUSTER AND DANIEL WESSEL, *A general extension theorem for complete partial orders*.
Department of Computer Science, University of Verona, Strada le Grazie 15, 37134 Verona, Italy.
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An invocation of Zorn's Lemma (ZL) often takes place within an indirect proof of a universal statement. Supposing towards a contradiction that there be any counterexample, the maximal counterexample provided by ZL helps—by a "one-step" argument—to the desired contradiction. Crucially though, this "one-step" does not depend on maximality, and in fact a more general method is hovering in the background, which is not limited to hypothetical counterexamples only.

Taking this into account, we distill a General Extension Theorem (GET) for complete partial orders, applicable to specific extension theorems such as the Hahn-Banach Theorem or Baer's Criterion. The intended meaning of GET is that the poset under consideration consists of partial extensions of which one is to be proved total. Its principle hypothesis encodes the "one-step" argument from before: that there be a function extending each partial extension by any potential element of its domain. As compared with the typical indirect proof with ZL of an extension theorem, GET postulates the existence of a total extension rather than a maximal one.

In ZF set theory, say, GET is an immediate consequence of ZL and, conversely, ZL follows from GET in a straightforward way; whence GET is a ZF–equivalent of the Axiom of Choice (AC). Attempting to deduce AC directly from GET has brought us to make an interesting move: the family of non-empty sets for which a choice function is sought needs to be replaced by a family of pointed sets! Needless to say, this has to be done very carefully, in order to ensure that AC does not follow trivially.

▸ GEMMA CAROTENUTO, *On the topological complexity of the density sets of the real line*.
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Given a metric space (X, d), equipped with a Borel measure μ, a measurable set $A \subseteq X$ is a *density set* if the points where A has density 1 are exactly the points of A. The main theme of this work is the study of the topological complexity of the density sets of the real line with the Lebesgue measure, and it is carried out from the point of view of descriptive set theory. In this context a density set is always in $\boldsymbol{\Pi}^0_3$, i.e. it is a countable intersection of sets in F_σ. We construct examples of an entire family true of $\boldsymbol{\Pi}^0_3$ density sets and an example of true $\boldsymbol{\Sigma}^0_2$ density set. Moreover, we find density sets in each class of the form $(n\text{-}\boldsymbol{\Pi}^0_1)^{\smile}$, that is the dual class of the differences of n-many closed sets. These results are obtained through two different strategies: one which is completely combinatorial in nature, and another one based on results which are analogous to the ones on the Cantor space in [1].

[1] Alessandro Andretta and Riccardo Camerlo, *The descriptive set theory of the Lebesgue Density Theorem*, ***Advances in Mathematics***, vol.234 (2013), no.0, pp.1–42.

[2] Gemma Carotenuto, ***On the topological complexity of the density sets of the real line***, Ph.D Thesis, 2015.

[3] Jean P. Tacchi, *Points de densit d'ensembles de Cantor*, ***European Journal of Combinatorics***, vol.16 (1995), no.6, pp.645–653.

▸ LONGYUN DING, *On equivalence relations generated by Schauder bases*.
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In this talk, a notion of Schauder equivalence relation $\mathbb{R}^{\mathbb{N}}/L$ is introduced, where L is a linear subspace of $\mathbb{R}^{\mathbb{N}}$ and the unit vectors $e_n = (0, 0, \cdots, 0, \overset{n}{1}, 0, \cdots)$ form a Schauder basis of L. The main theorem is to show that the following conditions are equivalent:

(1) the unit vector basis is boundedly complete;
(2) L is F_σ in $\mathbb{R}^{\mathbb{N}}$;
(3) $\mathbb{R}^{\mathbb{N}}/L$ is Borel reducible to $\mathbb{R}^{\mathbb{N}}/\ell_\infty$.

We show that Schauder equivalence relation generalized by any basis of ℓ_2 is Borel bireducible to $\mathbb{R}^{\mathbb{N}}/\ell_2$ itself, but it is not true for bases of c_0 or ℓ_1. Furthermore, among all Schauder equivalence relations generated by sequences in c_0, we find the minimum and the maximum elements with respect to Borel reducibility.

We also show that $\mathbb{R}^{\mathbb{N}}/\ell_p$ is Borel reducible to $\mathbb{R}^{\mathbb{N}}/J$ iff $p \leq 2$, where J is James' space.

▸ YURII KHOMSKII, *Regularity properties on the generalized reals*.
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We investigate regularity properties related to the property of Baire, in the setting of *generalized descriptive set theory*, i.e., the spaces 2^κ or κ^κ for regular uncountable κ satisfying $\kappa^{<\kappa} = \kappa$. Unlike the classical situation, generalized analytic sets typically do not satisfy regularity properties of this kind, and the generalized $\boldsymbol{\Delta}^1_1$-level reflects some (but not all) properties of the classical $\boldsymbol{\Delta}^1_2$-level. We present an abstract theory and apply it to a number of examples. There are still many open questions in this field, including the basic question of whether we are looking at the right kind of regularity properties.

This is joint work with Sy David Friedman and Vadim Kulikov.

CONTRIBUTED TALKS 21

Friday, 7 August • 4.00PM–6.00PM
Venue - PIV

► MICHAł TOMASZ GODZISZEWSKI, DARIUSZ KALOCIŃSKI, *Computational complexity of Barwise's Sentence and similar natural language constructions.*
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We investigate computational complexity of some similarity relations between finite orderings. Our motivation comes from natural language semantics. In a typical situation in the field we are given some natural language sentences and we look for their logical forms. This is a slightly modified example, mentioned by Barwise in [2] :

(1) The richer the country, the more powerful are some of its officials.

Following Barwise, we claim (1) seems to express that there is a homomorphism of one partial order into the other. If this is the case, then (1) cannot be formulated in the first-order logic (see [2] for a proof). Barwise argues that (1) may essentially involve second-order quantification. It seems that that a reasonable logical form for (1) would be:

(2) $$\exists f \forall x \forall y [x > y \Rightarrow (R(f(x), x) \wedge R(f(y), y) \wedge f(x) \succ f(y))],$$

where R stands for "is an official of", $>$ for "is richer than" and $\succ$ for "is more powerful than". (1) is an example of a language construction described schematically as "the ... the ... ". Some instances of this construction are first-order. Apart form (1), we provide additional examples of natural language statements that seem to involve other similarity relations between partial orders such as embedding and injective homomorphism. Finally, we answer questions about the computational complexity of recognizing the truth value of (1), and similar constructions, in finite models.

Definition 1. Let $\mathcal{A}$, $\mathcal{B}$ be strict posets and $f : A \to B$. f is a homomorphism of $\mathcal{A}$ into $\mathcal{B}$ iff $\forall x, y \in A(x <_A y \Rightarrow f(x) <_B f(y))$. We say $\mathcal{A}$ is homomorphic to $\mathcal{B}$, if there is a homomorphism from $\mathcal{A}$ to $\mathcal{B}$.

Definition 2 (Strict Partial Orders Homomorphism, SPOH).
Input: strict partial orders $\mathcal{A} = (A, <_A)$, $\mathcal{B} = (B, <_B)$.
Question: is there a homomorphism from $\mathcal{A}$ to $\mathcal{B}$?

Theorem 3. *SPOH is PTIME.*

Consider another example of a natural language statement:

(3)
The smarter the student the better are some of her individual presentations and the better are these presentations the smarter are students who performed them.

Definition 4. Let $\mathcal{A}$, $\mathcal{B}$ be strict posets and $f : A \to B$. f is an embedding of $\mathcal{A}$ into $\mathcal{B}$ iff f is injective and $\forall x, y \in A(x <_A y \Leftrightarrow f(x) <_B f(y))$. We say $\mathcal{A}$ embeds in $\mathcal{B}$ iff there is an embedding of $\mathcal{A}$ into $\mathcal{B}$.

Definition 5 (Strict Partial Orders Embedding, SPOE).
Input: strict partial orders $\mathcal{A} = (A, <_A)$, $\mathcal{B} = (B, <_B)$
Question: is there an embedding from $\mathcal{A}$ to $\mathcal{B}$?

Theorem 6. *SPOE is NP-complete.*

Definition 7 (Strict Partial Orders Embedding in Partition, SPOEP).
Input: strict partial orders $\mathcal{A}$, $\mathcal{B}$, a partition $\{B_a\}_{a \in A}$ such that $\bigcup_{a \in A} B_a \subseteq B$.
Question: is there an embedding f of $\mathcal{A}$ into $\mathcal{B}$ s.t. $f(a) \in B_a$, for every $a \in A$?

Theorem 8. *SPOEP is NP-complete.*

Definition 9 (Strict Posets Injective Homomorphism, SPOIH).
Input: strict partial orders $\mathcal{A} = (A, <_A)$, $\mathcal{B} = (B, <_B)$.
Question: is there a 1-1 homomorphism from $\mathcal{A}$ to $\mathcal{B}$?

Theorem 10. *SPOIH is NP-complete.*

We conclude by some remarks on how our results correspond to the simmilar research made by M. Mostowski and D. Wojtyniak in [1].

[1] Barwise J., *On branching quantifiers in English*, ***Journal of Philosophical Logic***, 8 (1979), pp.47-80.
[2] Mostowski M., Wojtyniak D., *Computational Complexity of the Semantics of Some Natural Language Constructions*, ***Annals of Pure and Applied Logic***, 127 (2004), pp.219-227.
[3] Garey M.R., Johnson D.S., ***Computers and Intractability: A Guide to the Theory of NP-Completeness***, W.H. Freeman, 1979.

► JACQUES DUPARC, ALESSANDRO FACCHINI, KEVIN FOURNIER, HENRYK MICHALEWSKI,
Inside the second level of the Mostowski-index hierarchy of the μ-calculus.
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Modal μ-calculus is the logic obtained by adding least and greatest fixpoint operators to modal logic. It has long been of great practical and theoretical interest in systems verification. The problem of understanding alternating least and greatest fixpoints gave rise to a powerful theory relating them to alternating parity automata and to parity games. In 1998, Bradfield showed that the alternation-depth hierarchy of the μ-calculus of tree languages does not collapse [2]. Later, Arnold and Niwinski proposed a much easier proof of the strictness of this hierarchy that relied on the descriptive set theoretical notion of Wadge reducibility [1], making it apparent that the Wadge ordering was a powerful tool to study the fine structure of this hierarchy.

A well-known result by Rabin states that any set of tree that is both Büchi and co-Büchi definable in monadic second order logic is also weakly definable. In terms of the μ-calculus, this result asserts that the ambiguous complexity class $\Delta_2 = \Sigma_2 \cap \Pi_2$ and the class $Comp(\Sigma_1, \Pi_1)$ – obtained from Σ_1 and Π_1 by a sequence of applications of the composition operation of the μ-calculus – are the same. However, as shown by Arnold and Santocanale in [3], this equality does not hold for higher levels of the fixed-point alternation-depth hierarchy of the μ-calculus of tree languages. With the help of the Wadge ordering we investigate the inequality $Comp(\Sigma_2, \Pi_2) \subsetneq \Delta_3$ and exhibit:

- $\phi_2(0)$ Wadge degrees inside $Comp(\Sigma_2, \Pi_2)$, and
- $\phi_3(0)$ Wadge degrees inside $\Delta_3 \setminus Comp(\Sigma_2, \Pi_2)$.

Where $\phi_n : On \to On$ is the Veblen function inductively defined by $\phi_0(x) = \omega^x$, ϕ_{n+1} enumerates the fixpoints of ϕ_n.

[1] Arnold, André and Niwiński, Damian, *Continuous separation of game languages*, ***Fundamenta Informaticae, vol. 81 (2007), no. 1, pp. 19–28.***
[2] Bradfield, Julian C, *The modal mu-calculus alternation hierarchy is strict*, ***Theoretical Computer Science, vol. 195 (1998), no. 2, pp. 133–153.***
[3] Santocanale, Luigi and Arnold, André, *Ambiguous classes in μ-calculi hierarchies*, ***Theoretical computer science, vol. 333 (2005), no. 1, pp. 265–296.***

▸ L. H. BUSTAMANTE AND A. T. MARTINS, *A note on descriptive complexity of k-SUM.*
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It was shown in [1] that the k-SUM is $W[1]$-complete. There, they obtained new kind of reductions to establish that the problem is in $W[1]$, by a reduction to k-Clique problem, and that it is $W[1]$-hard once again but differently. Here we consider the descriptive complexity of k-SUM, defined as the parameterized version of SUBSET-SUM, given another proof for k-SUM $\in W[1]$.

Formally, as defined in [1], the (k, M)*-SUM problem* is to determine, given n integers $x_1, \ldots, x_n \in [0, M]$ and an integer $s \in [0, M]$, if there exists a subset $S \subseteq [n]$ of size $|S| = k$ such that $\sum_{i \in S} x_i = s$. The k*-SUM problem* was defined as (k, n^{2k})-SUM.

The relation between the W-Hierarchy, the hierarcy of parameterized problems reducible to some weighted satisfiability problem, and the parameterized model checking problem for fragments of First Order Logic $\Sigma_{t,l}$ in some vocabulary τ was established by means of the following theorem.

THEOREM 1 ([2, 3]). *For* $t \geq 1, W[t] = [MC(STR[\tau], \Sigma^{FO}_{t,l})]^{FPT}$.

We can immediately represent an instance of k-SUM by a finite structure $\mathcal{A}$ over the vocabulary $\{R^2, =, \leq, PLUS^3, s\}$ with domain $[n^{2k}]$. Then k-SUM can be expressed by a family of formulas $\{\phi_k\} \in \Sigma^{FO}_1$ in the form:

$$(\exists u_1, \ldots, u_k, v_1, \ldots, v_k) \bigwedge_{1 \leq i,j \leq k} ((u_i \neq u_j) \wedge (v_i \neq v_j)) \wedge \bigwedge_{i=1}^{k} R(u_i, v_i) \wedge \left(\sum^{k} v_i = s \right),$$

where $R(i, j)$ is true when $x_i = j$, a constant $s \in [n^{2k}]$, a fixed k from the problem, and the sum that can be expressed by

$$(\exists s_1 s_2 \ldots s_{k-2}) PLUS(v_1, s_1, s) \wedge \bigwedge_{i=2}^{k-2} PLUS(v_i, s_i, s_{i-1}) \wedge PLUS(v_{k-1}, v_k, s_{k-2}).$$

Hence, in the form of Theorem (1) for the first level. This implies that k-SUM $\in W[1]$.

[1] ABBOUD, AMIR AND LEWI, KEVIN AND WILLIAMS, RYAN, *Losing Weight by Gaining Edges*, ***Algorithms - ESA 2014***, (AndreasS Schulz and Dorothea Wagner, ed.), Springer, Berlin Heidelberg, 2014, pp. 1–12.

[2] DOWNEY, RODNEY G AND FELLOWS, MICHAEL R AND REGAN, K, *Descriptive Complexity and the W Hierarchy*, ***Proof Complexity and Feasible Arithmetics: DIMACS Workshop, April 21-24, 1996***, (P. Beame and S. Buss, ed.), vol. 39, 1998, pp. 119–134.

[3] JÖRG FLUM AND MARTIN GROHE, *Fixed-parameter tractability, definability, and model checking*, ***SIAM Journal on Computing***, vol. 31 (2001), no. 1,pp. 113-145.

▸ ANAHIT CHUBARYAN, ARMINE CHUBARYAN, ARMAN TSHITOYAN, *Some notes about lower bounds for steps and sizes of proofs in Frege systems.*
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It is known that in Frege systems there are the trivial exponential upper bounds and only $\Omega(n^2)$ bounds of proof size and $\Omega(n)$ bounds of proof steps for tautologies with the size n [1]. We prove that for some sequence of tautologies φ_n the proof steps and the proof sizes in Frege systems are at least $|\varphi_n|\sqrt{\frac{|\varphi_n|}{\log_2^3(|\varphi_n|)}}$ and $\frac{|\varphi_n|^3}{\log_2^3(|\varphi_n|)}$ by order accordingly, where by $|\varphi_n|$ the size of φ_n is denoted.

Acknowledgment. This work is supported by Grant 13-1B246 of SSC of Government of RA.

[1] P. PUDLAK, *The Lengths of Proofs*, ***Handbook of proof theory, North-Holland***, 1998, pp. 547-637.

▸ NATALIA KORNEEVA, *Asynchronous automata transformations of prefix decidable and Buchi decidable infinite words.*
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In the talk we consider asynchronous automata transformations of prefix decidable and Buchi decidable infinite words over a finite alphabet and their degrees. Definitions of prefix decidable, Buchi decidable infinite words and degrees of asynchronous automata transformations can be found in [1] and [2], respectively.

The following theorems are the main results of the research:

Theorem 1. Let $(S, \Sigma, \Sigma', \delta, \omega, s_0)$ be a finite initial asynchronous automaton. If $x \in \Sigma^\infty$ is a prefix decidable infinite word, then so is $\omega(s_0, x) \in (\Sigma')^\infty$.

A similar result for Buchi decidable infinite words have been proved in [3].

Theorem 2. The degree structure of asynchronous automata transformations contains an atom consisting of Buchi decidable infinite words.

Theorem 3. The degree structure of asynchronous automata transformations contains an atom consisting of prefix decidable infinite words which are not Buchi decidable.

This work was supported by the RFBR, project 14-01-31200.

[1] M.N. VYALYI, A.A. RUBTSOV, *Decidability conditions for problems about automata reading infinite words*, ***Diskretnyi Analiz i Issledovanie Operatsii***, vol. 19 (2012), no. 2, pp. 3–18.

[2] N.N. KORNEEVA, *Degrees of asynchronously automaton transformations*, ***Russian Mathematics***, vol. 55 (2011), no. 3, pp. 26–35.

[3] ——— *On automaton transformations and monadic theories of infinite sequences*, ***Russian Mathematics***, vol. 55 (2011), no. 8, pp. 78–80.

CONTRIBUTED TALKS 22

Friday, 7 August • 4.00PM–6.00PM
Venue - P617

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Leon Chwistek's rational semantics and contemporary computation

The system of rational semantics (RS) was developed in the years 1929-1935 by a Polish logician, Leon Chwistek (1884-1944), together with Władysław Hetper and Jan Herzberg (Chwistek 1930,1935; Chwistek, Hetper, Hertzberg 1933a, 1933b). RS consists of several subsystems such as: elementary semantics; theoretical semantics; L metasystem and the complex systems (including the system of rational metamathematics) built using elements of all three. Additionally RS is structured by incorporating an early version of the constructive type theory, first developed in 1922 (Chwistek 1922; 1923, 1924).

The basic idea behind RS is to provide a complete theory of expressions suitable for the analysis of any existing formal language, as well as to create the logical machine, which would help to eliminate human intuition from formalised reasoning. The language of RS was from the outset meant to serve as a software tool for programming this automated device. In my presentation I will provide an outline of RS system architecture and will try to assess its applicability in the field of contemporary computational analysis of the formal systems.

Leon Chwistek, Zasady czystej teorii typów, Przegląd Filozoficzny, vol. XXV, z. 3 (1922), p. 359--391.

Leon Chwistek, Theory of Constructive Types, Rocznik Polskiego Towarzystwa Matematycznego, pt. I, II, (1923), p.9-48, pt.. III (1924), p.92-141.

Leon Chwistek, Computes Rendus du I-er Congresdes Mathematiques des Pays Slaves, Warszawa 1930, p.47-60.

Leon Chwistek, Władysław Hepter; Jan Herzberg, Podstawy metamatematyki racjonalnej, Bulletin International de l'Academie Polonaise des Sciences et des Lettres, vol.1. 1933(a), p. 253-254.

Leon Chwistek, Władysław Hepter, Jan Herzberg, Uwagi o podstawach metamatematyki racjonalnej [in] Bulletin International de l'Academie Polonaisedes Scienceset des Lettres, vol.2. 1933(b), p. 265-275.

Leon Chwistek, Chwistek Granice nauki. Zarys nauki i metodologii nauk ścisłych, Lwów-Warszawa: Książnica Atlas, 1935. (English ed. London: Harper 1946).

► DARIUSZ SUROWIK, *The Logic of Algorithmic Knowledge*.
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In the considerations on the representation of an algorithmic knowledge in the language of logic we usually assume, that an agent has immediate access to all logical consequences of his knowledge. It does not take into account a time an agent needs to conclude these consequences. In many cases, it is important not only knowledge about what the agent knows, but also knowledge about what he does not know in the particular moment of time.

In our talk we will consider the system of the Logic of Algorithmic Knowledge, in which we take into account the time an agent needs to conclude the logical consequences of his current knowledge. In the language of the discussed system it is possible modeling of the knowledge of rational agents, which has not a property of logical omniscience.

One of the main problems of logical formalization of knowledge is a description of the real agents. This aim can not be achieved if we not take into account some restrictions of knowledge resources, because the real agents, for example, have not unlimited memory. Epistemic modal logic (commonly used to formalize knowledge) are not the right logical tool for the formalization of reasoning taking into account the bounded resource of knowledge. I seems, the system of logic discussed in our talk realizes this purpose.

► PATRICK ALLO, *Hard and soft logical information*.
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The problem of accounting for acceptable uses of classically valid but paraconsistently invalid arguments is a recurrent theme in the history of paraconsistent logics. In recent publications [4, 3], Jc Beall has defended the rejection the *disjunctive syllogism* (DS) and *modus ponens* (MP) in the logic of paradox **LP**. He suggested in particular that since uses of DS and MP can lead us from truth to falsehood in the presence of contradictions [2], these cannot be warranted on purely logical grounds. The default application of these rules in inconsistency adaptive logics (see [5], and especially [6] for Priest's *Minimally inconsistent LP* or **MiLP**) should therefore not be considered part of logic proper.

On way to look at Beall's view is that logic merely presents us with options (made explicit in $\mathbf{LP}^+$, a multiple-conclusion presentation of **LP**), and that the assumption of consistency needed for MP and DS can only be motivated by extra-logical considerations. In **MiLP**, by contrast, in the absence of explicit counter-indications the consistent option is always the preferred option. Here, logic incorporates an ordering of logical options. Using a more traditional terminology, $\mathbf{LP}^+$ is motivated by the orthodox view that logical consequence is a strict conditional modality, whereas **MiLP** is motivated by the acceptance of forms of logical consequence that are variable conditional modalities based on logical preferences.

By generalising this stand-off to the question of whether logic should be knowledge-like hard information, or could include belief-like soft information as well [1], I focus on the modal nature of consequence and the structure of logical space, and develop an account of the nature of logical information that can be integrated in a philosophical account of non-monotonic consequence.

[1] Patrick Allo, *Logic, Reasoning, and Revision*, ***Theoria***, Early View (2015).

[2] Jc Beall, *Why Priest's reassurance is not reassuring*, ***Analysis***, vol. 72 (2012), no. 3, pp. 517–525.

[3] ——— *Strict-Choice Validities: A Note on a Familiar Pluralism*, ***Erkenntnis***, vol. 79 (2014), no. 2, pp. 301–307.

[4] ——— *Free of Detachment: Logic, Rationality, and Gluts*, ***Noûs***, vol. 49 (2015), no. 2, pp. 410–423.

[5] Diderik Batens, *Dynamic Dialectical Logics*, ***Paraconsistent Logic - Essays on the inconsistent*** (Graham Priest, Richard Routley and Jean Norman, editors), Philosophia Verlag, München / Hamden / Wien, 1989, pp. 187–217.

[6] Graham Priest, *Minimally inconsistent LP*, ***Studia Logica***, vol. 50 (1991), no. 2, pp. 321–331.

[7] ——— *The sun may not, indeed, rise tomorrow: a reply to Beall*, ***Analysis***, vol. 72 (2012), no. 4, pp. 739–741.

► PRZEMYSŁAW ANDRZEJ WAŁĘGA, *Default and non-monotonic spatial reasoning*.
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Commonsense spatial reasoning mechanisms, and reasoning methods about change of spatial relations between objects are crucial in order to model a wide range of dynamic application domains and are interesting from cognitive point of view. The role of space is ubiquitous, and thus domain-specific conclusions must necessarily also be concerned with spatial consistency. A number of approaches modelling spatial change have been introduced but there is hardly any logical approach that enables to perform effective non-monotonic and default reasoning. Our idea is to extend the well-known approaches, namely Reiter's Default Logic [3] and Moore's Autoepistemic Logic [2] in order to perform spatial reasoning. Although there are strong similarities between the abovementioned systems, it is interesting to investigate how each of them may be applied to spatial reasoning. The complexity of reasoning in a pure propositional Default Logic (as well as Autoepistemic Logic) is known [1] to be at the second level of the polynomial hierarchy, hence, unless the hierarchy collapses, it is strictly harder then reasoning in monotone logics – which is not that surprising.

During the presentation we describe motivations of working on non-monotonic and default spatial reasoning. Afterwards, we introduce a formalism extending propositional Default Logic that enables to perform effective reasoning about topological relations and does not increase the computational complexity. We establish the reasoning algorithm and its implementation. We investigate the difference between Default Logic and Autoepistemic Logic in case of possibility of performing such spatial reasoning, namely we describe if the same method may be used in Autoepistemic Logic and what are the advantages of using this logic. Finally, we present possible applications of non-monotonic and default spatial reasoning that include geographic information systems, computer-aided architecture design systems, cognitive spatial systems, visual interpretation and cognitive robotics, among others.

[1] Georg Gottlob, *Complexity results for nonmonotonic logics*, ***ournal of Logic and Computation***, vol. 2 (1992), no. 3, pp. 397–425.

[2] Robert C. Moore, *Semantical considerations on nonmonotonic logic*, ***Artificial intelligence***, vol. 25 (1985), no. 1, pp. 75–94.

[3] Raymond Reiter, *A logic for default reasoning*, ***Artificial intelligence***, vol. 13 (1980), no. 1, pp. 81–132.

▸ EVANGELIA ANTONAKOS, *On the lattice structure of generic common knowledge fixed points.*

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Multi-agent epistemic logics such as $\mathsf{S4}_n$ may be augmented with the traditional common knowledge operator C (as in $\mathsf{S4}_n^C$, [3]), a generic common knowledge operator J (as in $\mathsf{S4}_n^J$, [2]), or both (as in $\mathsf{S4}_n^{CJ}$, [1]). Generic common knowledge was introduced (as justified common knowledge) in [2] to represent mathematically the assumption of any finite prefix of individual knowledge modalities (which is routinely used in lieu of common knowledge in applications). J is not uniquely defined but can be any $\mathsf{S4}$ operator for which $J\varphi \to K_i\varphi$, for each agent i. It admits cut-elimiation ([2]) and its flexibility more closely adheres to the semantic presentation of many games. The characteristic feature of generic common knowledge J is that it implies – but is not equivalent to – iterated knowledge I, where $I\varphi = \varphi \wedge E\varphi \wedge EE\varphi \wedge E^3\varphi \ldots$, where $E\varphi = \bigwedge_{i=1}^n K_i\varphi$, *everyone knows* φ. By contrast, $C\varphi$ represents the whole of $I\varphi$.

It is well known that common knowledge $C\varphi$ is a solution to the fixed point equation $X \leftrightarrow E(\varphi \wedge X)$. If C it is the greatest fixed point ([3]), then J is any solution, and the universal modality is the least fixed point ([1]). Now consider $\mathsf{S4}_n^{CJ_*}$ which allows for multiple distinct generic common knowledge operators J_j. In a model of $\mathsf{S4}_n^{CJ_*}$, the accessibility relations for C and J_j, R_C and R_{J_j} respectively, are such that $R_C \subseteq R_{J_j}$ for all j.

Theorem 1. *$\mathsf{S4}_n^{CJ_*}$ is sound and complete with respect to $\mathsf{S4}_n^{CJ_*}$-models.*

In any model of $\mathsf{S4}_n^{CJ_*}$, the solutions to the fixed point equation $X \leftrightarrow E(\varphi \wedge X)$ are exactly the formulas $C\varphi$ and $J_j\varphi$ for each j. Considering these formulas, using $\to$ as an ordering yields a conditionally complete lattice with $C\varphi$ as the maximum element. If for some j, J_j corresponds to the universal modality, then that $J_j\varphi$ is the minimum element of the lattice.

Theorem 2. *For any lattice L with a maximum, there is an $\mathsf{S4}_n^{CJ_*}$-model such that the solutions to $X \leftrightarrow E(\varphi \wedge X)$ with the $\to$ ordering have the lattice structure of L.*

[1] E. Antonakos, ***Forms of Generic Common Knowledge***, PhD Thesis, City University of New York, 2013.

[2] S. Artemov, *Justified Common Knowledge*, ***Theoretical Computer Science***, vol. 357 (2006), no. 1, pp. 4–22.

[3] R. Fagin, J. Halpern, Y. Moses, and M. Vardi, ***Reasoning About Knowledge***, MIT Press, 1995.

▸ VLADIMIR STEPANOV, *Hypercomplex numbers for the semantics of self-reference statements.*

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In [1] it is described the dynamic model for the semantics of self-referential statements. In this model, the truth table for connection of biconditional ($\underline{\leftrightarrow}$) represents the Cayley table for the Klein four group:

$\underline{\leftrightarrow}$	**T**	**V**	**A**	**K**
T	**T**	**V**	**A**	**K**
V	**V**	**T**	**K**	**A**
A	**A**	**K**	**T**	**V**
K	**K**	**A**	**V**	**T**

Here **T**=True, **V**=TruthTeller, **A**=Liar, $\mathbf{K}=(\mathbf{V}\underline{\leftrightarrow}\mathbf{A})$. $\mathbf{V^2}=\mathbf{A^2}=\mathbf{K^2}=\mathbf{VAK}=\mathbf{T}$.

The Hypercomplex Hypothesis: We postulate that truth space of self-reference statements is a hypercomplex structure, so that the units $\{\ \mathbf{V}, \mathbf{A}, \mathbf{K}\ \}$ represent dimensions of truth space of properly self-reference statements , while the scalar **T** represents a classical statements. As the multiplication table for components of hypercomplex numbers the Cayley table for the Klein four group is used.

This property we try to use for recording estimates of logical formulas in the form of a hypercomplex numbers: $\mathbf{Q} = a_0\mathbf{T} + a_1\mathbf{V} + a_2\mathbf{A} + a_3\mathbf{K}$. Here $a_0 \div a_3$ take the values 1, $\sim$, 0, which means that the component may be positive or negative occurrence, or may not have it all.

[1] Stepanov, V., *Truth theory for logic of self-reference statements as a quaternion structure.*, ***Abstract Booklet, Logic Colloquium***, Vienna Summer of Logic, 2014, pp. 97-98.

CONTRIBUTED TALKS 23

Friday, 7 August • 4.00PM–6.00PM
Venue - P673

▸ EMANUELE BOTTAZZI, *A nonstandard model for an ill-posed parabolic equation.*
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We study a nonstandard formulation of the problem

$$(1)\qquad \begin{aligned} u_t(x,t) &= \Delta f(u(x,t)),\ x \in \Omega \subseteq \mathbb{R}^n,\ t \in \mathbb{R} \\ u(x,0) &= u_0(x),\ x \in \Omega. \end{aligned}$$

Equations of this form arise in many applications, ranging from the dynamics of aggregating populations to image enhancing. It is well-known that, if $f \in C^1(\mathbb{R})$ and $f'(x) < 0$ for all $x \in (a,b)$, the aforementioned problem is ill-posed and only has weak solutions in the class of Young measures. Moreover, uniqueness of such solutions is in general not known. We consider a hyperfinite domain Ψ satisfying $\Omega \subset \Psi \subset {}^*\Omega$ and we discretize equation (1) in space by means of finite differences with an infinitesimal step ε, obtaining the formally equivalent hyperfinite system of ODEs

$$(2)\qquad u_t(x,t) = \sum_{i=1}^{n} \frac{\phi(u(x+\varepsilon e_i,t)) - 2\phi(u(x,t)) + \phi(u(x-\varepsilon e_i,t))}{\varepsilon^2}$$

where $x \in \Psi$ and where e_i is the i-th element of the canonical basis of ${}^*\mathbb{R}^n$. This nonstandard model can be derived from very simple physical principles and shares many properties with the nonstandard model for the diffusion equation studied in [1]. It turns out that system (2) has a unique solution under the hypothesis that f is Lipschitz continuous. Moreover, the solution of this system satisfy many relevant physical properties, chiefly among them an entropy condition that characterizes physically admissible solutions to (1).

[1] Feng Hanqiao, D. F. St. Mary and Frank Wattenberg, *Applications of nonstandard analysis to partial differential equations-I. The diffusion equation*, ***Mathematical Modelling***, vol. 7 (1986), pp. 507–523.

▸ REMCO HEESEN, *Communism and the incentive to share in science.*
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The communist norm requires that scientists widely share the results of their work. Where did this norm come from, and how does it persist? Michael Strevens [1] provides a partial answer to these questions by showing that scientists should be willing to sign a social contract that mandates sharing. However, he also argues that it is not in an individual credit-maximizing scientist's interest to follow this norm. This means that something in addition to scientists' interest in credit maximization is needed to explain the communist norm. I argue against Strevens that individual scientists can rationally conform to the communist norm, even in the absence of a social contract or other ways of enforcing the norm, by proving results to this effect in a game-theoretic model. This shows that the incentives provided to scientists through the priority rule are sufficient to explain both the origins and the persistence of the communist norm.

[1] Michael Strevens, *Scientific Sharing: Communism and the Social Contract*, ***Scientific Collaboration and Collective Knowledge*** (Thomas Boyer-Kassem and Conor Mayo-Wilson and Michael Weisberg, editors), Oxford University Press, Oxford, forthcoming.

▸ FLORIAN PELUPESSY, *Finitisations of second order principles.*
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One of the standard techniques for obtaining statements φ which are independent from a first order theory is to use a compactness argument on a strong second order principle. For example, the Paris–Harrington theorem [2], which is independent of Peano Arithmetic, is derived from Ramsey's theorem using a textbook example of such a proof. In the case of the Paris–Harrington theorem one can, inspired by the "finitary" infinite pigeonhole principle from [1] generalise φ to a statement which is equivalent to Ramsey's theorem. Similar phenomena can be observed for, among others, Dickson's lemma, the well-ordering of certain ordinals and Kruskal's tree theorem.

We examine different such finitisations with the goal of exploring possible connections between first order independence and logical principles from reverse mathematics.

[1] Jaime Gaspar and Ulrich Kohlenbach, *On Tao's "finitary" infinite pigeonhole principle*, ***The Journal of Symbolic Logic***, vol. 75 (2010), no. 1, pp. 355-371.

[2] J. Paris and L. Harrington, *A Mathematical Incompleteness in Peano Arithmetic*, ***Handbook for Mathematical Logic*** (J. Barwise), Amsterdam, Netherlands: North-Holland, 1977, pp. 1133-1142.

[3] Stephen G. Simpson, ***Subsystems of second order arithmetic***, Perspectives in logic (2nd edition), Cambridge University Press, 2009.

ANTONIO VINCENZI. ***Some Conceptual Hypotheses on Information, Entropy, Chaos and Implicit Contradictions.***
via Belvedere 17/1, Albissola Mare. 17012 Italy
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A Conceptual Approach to Physics of Information. Working in an abstract deterministic physical context, we propose the following conceptual, abstract characterizations of

- *physical information*: an interaction between a physical system *M* (the *message*) and a physical system *R* (the *receptor*) such that the quantity of energy changing forms in the interaction $M+R$ is bigger than the energy contained in *M,*

that allows to obtain abstract characterizations of *order*, *disorder*, *entropy*, *chaos*,… that not necessarily depend on statistical or thermodynamic considerations.

Logic Analogies. Analogously, the following notion of

- *logical information:* a process where a formula determines a logical process with a complexity bigger than the complexity of the formula,

(like in the case in which a formula determines a *deduction process* or a *satisfaction process*), suggests that complexity can play the same role of the variation of energy forms.

Chaos and Implicit Contradictions. A technical consequence of this analogy concerns the *'contradictory' nature of chaos.* If chaotic systems are characterized by

- a behavior that *contains many bifurcations* (BIF), or
- the fact that small variations of causes determine big variations of effects (the *sensitivity to initial* condition or SIC),

we have:

BIF Theorem. *Let $\mathscr{L}$ be a model–theoretic logic that express the usual description of the dynamical systems. If $\mathscr{L}$ characterizes a dynamical system with BIF then* COMP($\mathscr{L}$) *fails.*

SIC Theorem. *Let $\mathscr{L}_1 \leq \mathscr{L}_2 \leq \mathscr{L}_3$ be model–theoretic logics such that*
- *$\mathscr{L}_1$ characterizes the usual description of the dynamical systems.*
- *$\mathscr{L}_2$ expresses the measuring approximations for $\mathscr{L}_1$.*
- PPP($\mathscr{L}_2$,$\mathscr{L}_3$).
- *$\mathscr{L}_2$ characterizes a dynamical system with* SIC.

Then BETH($\mathscr{L}_1$,$\mathscr{L}_2$) *fails.*

Assuming that *the counterexamples of Compactness of Definability are implicit forms of contradictions*, we have that a *logic description of chaotic systems generates implicit contradictions.*

CONTRIBUTED TALKS 24

Friday, 7 August • 4.00PM–6.00PM
Venue - P674

► EVGENY GORDON, *Continuous vs Discrete*.
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In the second half of the last century a new point of view on interrelation between the continuous and discrete mathematics emerged. According to it the continuous mathematics is an approximation of the discrete one, but not vice versa. The reason of this emergence is the widespread use of computers in both applied and theoretical research. However, the formalization of mathematics based on this point of view in the framework of Cantor's Set Theory meets serious difficulties, because we need to deal with not well defined collections, like very big numbers, or numbers far enough of computer boundaries, that depend on concrete problems or points of views. Maybe, the difficulties in mathematically rigorous justification of theoretical physics have the same reason the axiom of least upper bound is too strong idealization for physics. A new axiomatic system (**NNST** Naive Nonstandard Set Theory) based on ideas of A. Robinson's Nonstandard Analysis and P. Vopenka's Alternative Set Theory will be presented in this talk. The idea of approximation of discrete structures by continuous ones is implemented in this theory as follows. Continuous structures emerge from finite *very big finite ones* as factorizations of *accessible substructures* of these finite structures by some *indiscirnability relations*. The properties in italic here are not well defined ones. We discuss some theorems formulated and proved in the framework of NNST related to computer simulations of continuous structures, which have clear intuitive sense, can be monitored in computer experiments, but whose formulations in the framework of Cantor's Set Theory are irrelevant, if not to say unreadable.

This talk is dedicated to the blessed memory of outstanding Czech mathematician Petr Vopenka, who passed away on March 20, 2015.

► KAROLINA KRZYŻANOWSKA, PAULA QUINON, *Exact numerals as vague quantifiers*.
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When we say that the population of Norway is 5 million people, we do not usually mean that there are exactly 5 million people living in this country. On the contrary, if the country happened to have a population of no more and no less than 5 million, we would need to add "exactly" to convey this information. Why do phrases like "5 million," "two hundreds" or even, in some contexts, numerals denoting smaller numbers like "forty" tend to be interpreted as approximations [3]? Is it only a matter of pragmatics or is the denotation of these numerals vague? Is the sentence "Norway has a population of 5 million" true if the exact number is 5,109,059? Or is it false but assertable?

Drawing from recent developments in cognitive science [1, 2], we will argue that our preference for vague interpretation of numerals might be due to the approximate number system (ANS) being the primary source of our mental representation of numbers, and hence using exact numerals as vague quantifiers is not only a matter of convention. ANS forms one of the core cognitive systems responsible for our representations of quantitative information. Unlike the verbal representations of discrete quantities, ANS-related representations are believed to be analogue and intrinsically imprecise. In the proposed study, we investigate how the practice of use of exact numerals as vague quantifiers correlates with the structure of ANS.

[1] Susan Carey, ***The Origin of Concepts***, Oxford University Press, 2009.
[2] Stanislas Dehaene, ***The Number Sense: How the Mind Creates Mathematics***, Oxford University Press, 2011.
[3] Manfred Krifka, *Approximate interpretations of number words. The case for strategic communication*, ***Theory and Evidence in Semantics*** (E. Hinrichs and J. Nerbonne, eds.), CSLI Publications, Stanford, pp. 109–132.

► RANJAN MUKHOPADHYAY, *Is Separativity an Additional Constraint?*.
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The intelim rules when taken to define the meaning of a logical constant are supposed to satisfy certain constraints, viz., (1) uniqueness (Belnap), (2) conservative extension (Belnap), (3) stability (Dummett) and (4) separativity (Bendall). Introduction of a new constant through intelim rules has to be separative in that it has to satisfy the condition of conservative extension separately with respect to each set of intelim rules for the different constants already present in the language before the extension is attempted. When language L0 has no constants and is being extended to L1 with respect to constant C1, the set of intelim rules for C1 has to satisfy the condition of conservative extension with respect to the structural rules in L0. When this L1 is attempted to be extended to L2 with respect to another constant C2, the set of intelim rules for C2, has to satisfy the condition of conservative extension with respect to the structural rules (i.e., L0), as well as the rules for C1 in L1 (i.e., L1). And so on for L3, L4, etc. One can investigate whether separativity would, as an example, demand that for C3, one should check conservation with respect to four sub-languages, viz., L0, L01, L02, and L2 separately (where L01 and L02 are respectively languages which contain just structural rules plus rules for C1, and, just structural rules plus rules for C2), or, whether checking conservation with respect to whole L2 would be enough. Separativity as an additional constraint for defining meanings of logical constants over and above the other three should demand the former. It is proposed that any proof of conservation with respect to a more complex language can be transformed into a proof of conservation with respect to any of its sub-languages.

► FRODE BJØRDAL, *Librationist Capture and Domination of Definable Real Numbers*.
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[1] develops the librationist system £ which gives a novel type free approach to the semantical and set theoretical paradoxes and the foundation of mathematics, and [2] makes many matters more precise and gives new and stronger results. While [1] shows that £ accounts for transfinitely iterated inductive definitions + Bar Induction and thus surpasses the Big Five of the Reverse Mathematics Program in strength, [2] shows that £ + The Skolem Cannon + The Fraenkel Postulate gives an interpretation of ZFC if ZFC is consistent through extending an interpretation of ZF by [4] in a system S which is ZF minus extensionality with collection and weak power. In £ the operation *librationist capture* is instrumental in appropriate contexts where it entails *collection*, *specification* and *choice*. The novel impredicative operation *domination* is

based upon a utilisation of the librationist truth predicate, and domination supplants the power set operation which (as shown in section 7 of [1]) turns out to be paradoxical in £. The domination operation invokes the impredicative fixed point operation we call *manifestation point* that was articulated for precedent type free systems in [3] and has roots in [5] and earlier work by Kleene and Gödel. We show how we may combine the use of librationist capture and domination to isolate precisely the definable real numbers in £, and the domination operation ensures that the definable real numbers are Dedekind complete. Importantly, an isolation such as we provide of definable real numbers in £ is not possible in classical set theories.

[1] F. Bjørdal, *Librationist Closures of the Paradoxes*, ***Logic and Logical Philosophy***, vol. 21 (2012), no. 4, pp. 323–361.

[2] F. Bjørdal, *Elements of Librationism*, ***http://arxiv.org/abs/1407.3877***

[3] A. Cantini, ***Logical Frameworks for Truth and Abstraction***, Studies in Logic and the Foundation of Mathematics vol. 135, Elsevier, 1996.

[4] H. Friedman, *The Consistency of Classical Set Theory Relative to a Set Theory with Intuitionistic Logic*, ***The Journal of Symbolic Logi***, vol. 38 (1973), no. 2, pp. 315–319.

[5] A. Visser, *Semantics and the Liar Paradox*, ***Handbook of Philosophical Logic vol. 4*** (D. Gabbay and F. Guenthner, editors), D. Reidel, 1989, pp. 617–706.

▸ JAN WOLENSKI, *The World of Logic*.
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There are at least three views concerning of what is the world of logic: (a) logic deals with the real world in a way; (b) logic is true in all models (worlds) and does not distinguish any particular world; (c) the world of logic consists of logical values. I will focus on (b) and (c). The view (b) regards the (unrestricted) universality as the basic property of logic. It can be justified by metalogic, especially by the completeness theorem and the fact that logic does not distinguish any extralogical content (object, item). The view (b) leads to the question, how many logical values there are. The simplest answer, captured by the principle of bivalence, is the world of logic consists exactly (at least and at most) of two elements. However, it is not a logical or metalogical rule and, thereby, the principle of bivalence can be consistently rejected. Thereby, we can construct various systems, for instance, many-valued logics, logics with truth-value gaps, fuzzy logic or probabilistic logics. Both views (b) and (c) have important consequences for the question "What is logic?", basic for the philosophy of logic. For instance, if logic is to be universal, higher-order logic and most systems of modal logic can be questioned as belonging to the logic. The view (c) invokes the problem which logic has a priority as the logic. Possible arguments pro and contra particular answers are closely related to the debate concerning monism and pluralism in the philosophy of logic.

▸ JEAN-YVES BEZIAU, *Round squares are no contradictions*.
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When talking about contradictions many people think of a round square as a typical example. We will explain in this talk that this is the result of a confusion between two notions of oppositions: contradiction and contrariety. The distinction goes back to Aristotle but it seems that up to now it has not been firmly implemented in the mind of many rational animals nor in their languages. According to the square of opposition, two propositions are contradictory iff they cannot be true and cannot be false together and they are contrary iff they cannot be true together but can be false together (about recent works about the square, see [1] and [3])

The propositions "X is a square" and "X is a circle" cannot be true together according to the standard definitions of these geometrical objects, but they can be false together: X can be a triangle, something which is neither a square, nor a circle. A round square is a contrariety, not a contradiction. Aristotle insisted that there were two different kinds of oppositions, from this distinction grew a theory of oppositions that was later on shaped in a diagram by Apuleius and Boethius. It is easy to find examples of contrarieties, but not so of contradictions.

Many pairs of famous oppositions are rather contraries: black and white (think of the rainbow), right and left (think of the center), day and night (think of dawn or twilight, happy and sad (think of insensibility), noise and silence (think of music), etc. Examples of "real" contradictions are generally from mathematics: odd and even, curved and straight, one and many, finite and infinite. We can indeed wonder if there are any contradictions in (non-mathematical) reality or if it is just an abstraction of our mind expressed through classical negation according to which p and $\neg p$ is a contradiction.

Finally we point out that in paraconsistent logic (see e.g. [2]) contrary to what many people say, there is no true contradictions, but at best fake contradictions. In those logcis the idea is to have a negation for which the law of exploison fails: $p, \neg p \not\models q$. Using a very general model-theroretical framework, this means that p and $\neg p$ can be true together and therefore does not form a contradiction according to the square definition.

[1] Jean-Yves Beziau, *The New Rising of the Square of Opposition*, ***Around and Beyond the Square of Opposition*** (J.-Y.Beziau and D.Jacquette, editors), Birkhäuser, Basel, 2012, pp.6–24.

[2] J.-Y.Beziau, W.A.Carnielli and D.M.Gabbay editors. ***, Handbook of Paraconsistency***, College Publication, London, 2007.

[3] J.-Y.Beziau and G.Payette editors. ***The Square of Opposition - a General Framework for Cognition***, Peter Lang, Bern, 2012.

CONTRIBUTED TALKS 25

Friday, 7 August • 4.00PM–6.00PM
Venue - P722

▸ LUCA SAN MAURO, *Universal binary relations, preorders, and graphs*.
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Computable reducibility is a natural way to classify equivalence relations on ω according to their complexity. This reducibility is defined as follows:

Let R and S be two equivalence relations. We say that R is *computably reducible* to S iff there is a computable function f s.t., for all $x, y \in \omega$, the following holds:

$$xRy \Leftrightarrow f(x)Sf(y).$$

In literature, the degree structure generated by computable reducibility has been largely investigated. In particular, one the most prominent problem in the area has been that of characterizing universal equivalence relations, i.e. relations to which all others relations, of a given complexity, can be reduced. For instance, a rich theory for universal computably enumerable equivalence relations has been formulated. Nonetheless, most results do not extend to the whole arithmetical hierarchy. In fact, while, for each n, it is easy to build a Σ_n equivalence relation which is universal, on the other hand, in [2] authors prove that there is no universal Π_n for $n \geq 2$.

Thus, in this talk we consider the problem of universality in a more general context than that of equivalence relations. First, we prove that, contrary to the case of equivalence relations, for each level of the arithmetical hierarchy there is a universal binary relation. Then we show how to make use of this latter construction in order to obtain a similar result also for preorders (i.e., reflexive and transitive binary relations) and graphs (i.e. symmetric binary relations).

[1] Uri Andrews, Steffen Lempp, Joseph S. Miller, Keng Meng Ng, Luca San Mauro, Andrea Sorbi, *Universal computably enumerable equivalence relations*, ***The Journal of Symbolic Logic***, vol. 79 (2014), no. 1, pp. 60–88.

[2] Egor Ianovski, Russell Miller, Keng Meng Ng, André Nies, *Complexity of equivalence relations and preorders from computability theory*, ***The Journal of Symbolic Logic***, vol. 79 (2015), no. 3, pp. 859–881.

▸ SERGEY OSPICHEV, *Computable numberings of partial computable functionals*.
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Study the cardinality and the structure of Rogers semilattices of families of various objects is one of the main questions in numbering theory. Here we concentrate our interest on partial computable functionals of finite types.

Let's define *functional type*. Let T will be the set of all types.

1. $0 \in T$;
2. if σ,τ are types, then $(\sigma \times \tau)$ and $(\sigma|\tau)$ are also types;
3. T - minimal set, satisfying 1 and 2.

Now we define *partial computable functionals*. Let C_σ be family of all partial computable functionals of type σ. Let $C_0 \rightleftharpoons \mathcal{C}$ be the family of all partial computable functions. If C_σ and C_τ are already defined, then $C_{(\sigma\times\tau)} \rightleftharpoons C_\sigma \times C_\tau$ and $C_{(\sigma|\tau)} \rightleftharpoons \mathfrak{Mor}(C_\sigma, C_\tau)$.

In work are proven

Theorem. *For any $\sigma \in T$ there is friedberg numbering of family C_σ.*

Theorem. *For any $\sigma \in T$ there is positive undecidable numbering of family C_σ.*

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▸ MANAT MUSTAFA, *Reductions between Types of Numberings*.
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The theory of numberings is one of the fundamental topics in computability theory and mathematical logic. It is basically due to Gödel's idea to code countable families of objects by numbers, so that objects of the family can be effectively identified with numbers, or indices, and studied from their indices. While numberings are a powerful tool to use the set of natural numbers in order to study families of constructive objects, they are an interesting object of study in themselves: Here, an important device is that of reducibility between numberings, where a numbering is reducible to another numbering, if there is an effective way to go from indices of an object in the first numbering to indices of the same object in the second numbering. Thus the relative complexity of numberings of objects of a same family can be measured by this notion of reducibility, and gives rise to the so called Rogers upper semilattice of the family, whose elements are the degrees of numberings; H. Rogers[1] initiated the study of the semilattice of numberings under many-one reduction and Ershov [4, 5, 6] transferred it in particular to the study of the k-r.e. and, more generally, α-r.e. sets. The overall goal of this talk is to show some reductions between various types of numberings:

- If a k-r.e. numbering can realise a certain type of Rogers semilattice, so can a $(k+1)$-r.e. numberings or, more general, every $(\alpha+k)$-r.e. numbering where α is a computable ordinal;
- Every type of Rogers semilattice realised by an r.e. numbering is also realised by an α-r.e. for every computable ordinal α which is not a power of ω and which is not 0 while if α is a power of ω then there is no α-r.e. numbering without minimal numberings in the Rogers semilattice (which stands in contrast to the r.e. case);

This is joint work with F. Stephan and Ian Herbert from National University of Singapore.

[1] H. Rogers, *Gödel numberings of partial computable functions.*, ***J. Symbolic Logic,***,1958, v. 23, no. 3, pp. 4957.

[2] S. Badaev and S. Goncharov., *The theory of numberings: open problems.*, ***Computability Theory and its Applications*** (P. A. Cholak, S. Lempp, M. Lerman, and R. A. Shore, editors), American Mathematical Society, Providence, vol. 257, 2000, pp. 23–38.

[3] S. Goncharov and A. Sorbi, *Generalized computable numerations and nontrivial Rogers semilattices*, ***Algebra and Logic***, vol. 36 (1997), no. 6, pp. 359–369

[4] Yuri L. Ershov., *A certain hierarchy of sets I* , ***Algebra i Logika*** , 7(1):47–74, 1968.

[5] Yuri L. Ershov., *A certain hierarchy of sets II* , ***Algebra i Logika*** , 7(4):15–47, 1968.

[6] Yuri L. Ershov., *A certain hierarchy of sets III* , ***Algebra i Logika*** ,9:34–51, 1970.

▸ ASSYLBEK ISSAKHOV, *A–computable numberings of the families of total functions*.
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Following [1], we say that a numbering $\nu : \omega \mapsto \mathcal{F}$ of a family of A–computable functions is A–computable if the binary function $\nu(n)(x)$ is A–computable. In [2], it was posed several natural questions on numberings that are computable relative to an arbitrary oracle. We give answers for some of them below.

Theorem 1. *Let A be an arbitrary set and F be an infinite A–computable family of total functions. If F has at least two non-equivalent A–computable Friedberg numberings, then F has infinitely many pairwise non-equivalent A–computable Friedberg numberings.*

Theorem 2. *Let A be a hyperimmune set. If A–computable family F of total functions contains at least two functions, then F has no principal A–computable numbering.*

Remind, [3], that every nonzero degree comparable with $0'$ is hyperimmune.

Note that, for every A such that $\emptyset' \leq_T A$, it was shown, [4], that an infinite A–computable family F of total functions has, up to equivalence, infinitely many A–computable Friedberg numberings; and if F contains at least two functions, then F has no principal A–computable numbering.

[1] S. S. Goncharov and A. Sorbi, *Generalized computable numerations and nontrivial Rogers semilattices*, ***Algebra and Logic***, vol. 36 (1997), no. 6, pp. 359–369.

[2] S. A. Badaev and S. S. Goncharov, *Generalized computable universal numberings*, ***Algebra and Logic***, vol. 53 (2014), no. 5, pp. 355–364.

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[4] A. A. Issakhov, *Ideals without minimal elements in Rogers semilattices*, ***Algebra and Logic***, to appear.

▸ J. TUSSUPOV, M. SAMBETBAEVA, K. JETPISOV, A. MUKHANOVA,
Formalization of Ontology and its Algorithmic Properties.
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We will consider models of the formalization of ontology and problems on algorithmic complexity of isomorphic models and connections with Scott families, for more details see [1], [2].

We define a countable model of the formalization of ontology as a structure $\mathcal{A}$ of the signature $\sigma = \{P_i^1, R^2, E^2 : i \in \omega\}$ where predicates satisfy properties:

1. Predicates P_i form a partition of the set $|\mathcal{A}|$, i.e. $\exists x P_i(x) \wedge \neg \exists y (P_i(y) \wedge P_j(y))$ for all $i, j \in \omega, i \neq j$.
2. $\forall x, y((\neg R(x,x) \wedge (R(x,y) \rightarrow R(y,x))) \wedge (R(x,y) \wedge R(y,z) \rightarrow \neg R(x,z)))$;
3. $\exists x \exists y (P_i(x) \wedge P_{i+1}(y) \wedge R(x,y))$ for all $i \in \omega$;
4. $\forall x, y, z(E(x,y) \wedge R(x,z) \rightarrow R(y,z))$;
5. $\forall x, y((P_i(x) \wedge \neg P_i(y)) \rightarrow \neg E(x,y))$.

Let $\mathcal{A}$ be a computable structure.

We say that $\mathcal{A}$ is $\Delta^0_\alpha-$*categorical* if for all computable $\mathcal{B} \cong \mathcal{A}$, there is a $\Delta^0_\alpha-$isomorphism from $\mathcal{A}$ to $\mathcal{B}$. We say that $\mathcal{A}$ is a *relatively* $\Delta^0_\alpha-$categorical if for all computable $\mathcal{B} \cong \mathcal{A}$, there is a $\Delta^0_\alpha(\mathcal{B})-$isomorphism from $\mathcal{A}$ to $\mathcal{B}$.

A *Scott family* for $\mathcal{A}$ is the set Φ of formulas, with a fixed tuple of $\bar{c}$ in $\mathcal{A}$, such that

1. each tuple of parameters in $\mathcal{A}$ satisfies some formula $\varphi \in \Phi$, and
2. if both $\bar{a}$, $\bar{b}$ satisfy the same formula $\varphi \in \Phi$, then there is an automorphism of $\mathcal{A}$ mapping $\bar{a}$ to $\bar{b}$.

A *formally* $\Sigma^0_\alpha-$*Scott family* is a $\Sigma^0_\alpha-$Scott family that is made up of "computable" $\Sigma_\alpha-$formulas.

Let $\mathcal{A}$ be a computable structure and R be a relation on $\mathcal{A}$. We say that R is *intrinsically* Σ^0_α if in all computable $\mathcal{B} \cong \mathcal{A}$ the image of R in $\mathcal{B}$ is Σ^0_α.

We say that R is *relatively intrinsically* Σ^0_α if in all computable $\mathcal{B} \cong \mathcal{A}$, the image of R is $\Sigma^0_\alpha(\mathcal{B})$.

We say that R is *intrinsically* if for each automorphism f of the structure $\mathcal{A}$ the image $f(R) \subseteq R$.

Let $\mathcal{A}$ be a formalization of ontology, i.e. a structure of signature σ.

Theorem 1. For each computable successor ordinal α and for each finite n there is a computable structure $\mathcal{A}$ of the signature σ with the $\Delta^0_\alpha-$dimension n.

Theorem 2. For each computable successor ordinal α there is a structure $\mathcal{A}$ of the signature σ with presentations in just the degrees of sets X such that $\Delta^0_\alpha(X) \neq \Delta^0_\alpha$. In particular, for each finite n there is a structure $\mathcal{A}$ with presentations in just the $non-low_n$ degrees.

Theorem 3. For each computable ordinal α there is a computable structure $\mathcal{A}$ of the signature σ that is $\Delta^0_\alpha-$ categorical but not relatively Δ^0_α (and without formally $\Sigma^0_\alpha-$Scott family).

Theorem 4. For each computable ordinal α there is a computable structure $\mathcal{A}$ of the signature σ with added relation R such that R is intrinsically Σ^0_α but not relatively intrinsically Σ^0_α.

[1] J. Chisholm, E. B. Fokina, S. S. Goncharov, V. S. Harizanov, J. F. Knight, and S. Miller. *Intrinsic bounds on complexity and definability at limit levels.* ***J. of Symbolic Logic,*** Vol.74, No.3,2009, pp.1047-1060.

[2] Goncharov S. S., *Isomorphisms and definable relations on Computable Models*, ***Proceeding of the Logic Colloquium 2005, Athens***, pp.26–45

▸ STANISLAV O. SPERANSKI,
Some new definability and complexity results in monadic second-order arithmetic.
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We say that a monadic second-order formula is Π^1_n iff it has the form

$$\forall X_1 \, \exists X_2 \, \forall X_3 \, \ldots \, X_n \, \Psi$$

with $X_1, X_2, X_3, \ldots, X_n$ set variables and Ψ containing no set quantifiers. Let $\mathfrak{A}$ be a structure (of some signature) with domain $\mathbb{N}$. Consider the following properties:

ACP for every positive integer n, the set of Π^1_n-sentences true in $\mathfrak{A}$ is Π^1_n-complete;

ADP for every positive integer n, if a set of natural numbers is Π^1_n-definable (i.e. by a Π^1_n-formula with one free number variable) in the standard model $\mathfrak{N}$ of arithmetic and closed under automorphisms of $\mathfrak{A}$, then it is Π^1_n-definable in $\mathfrak{A}$.

We shall focus on some naturally arising weak substructures of $\mathfrak{N}$—in fact, their first-order theories will always be decidable. As was shown earlier in [3],

$$\langle \mathbb{N}, +, = \rangle \text{ has ACP and ADP,} \quad \text{and} \quad \langle \mathbb{N}, \times, = \rangle \text{ has ACP.}$$

Among other things, I shall significantly extend and generalise the latter result.

We use Cop and Div to denote the coprimeness relation and the divisibility relation respectively. Given a prime p, let bc_p be the function which maps each $(x, y) \in \mathbb{N} \times \mathbb{N}$ into $\binom{x+y}{x} \bmod p$—so $\langle \mathbb{N}, \mathsf{bc}_p, = \rangle$ is called *Pascal's triangle modulo p*.

Theorem 1. *$\langle \mathbb{N}, \mathsf{Cop} \rangle$ and all $\langle \mathbb{N}, \mathsf{bc}_p, = \rangle$ have both* ACP *and* ADP.

Furthermore the proof provides a method which can be used in other situations.

Theorem 2. *If* Div *is first-order definable in $\mathfrak{A}$, then $\mathfrak{A}$ has* ADP.

In particular this solves the open problems stated in [3].

Remark: of course one can introduce bc_k for any $k \geqslant 2$; however, as was proved in [1, 2], if k is not a prime, then $+$ is first-order definable in $\langle \mathbb{N}, \mathsf{bc}_k, = \rangle$; thus, whenever k is not a prime, $\langle \mathbb{N}, \mathsf{bc}_k, = \rangle$ has ACP and ADP—because $\langle \mathbb{N}, +, = \rangle$ has them.

[1] A. Bès, *On Pascal triangles modulo a prime power*, ***Annals of Pure and Applied Logic***, vol. 89 (1997), no. 1, pp. 17–35.

[2] I. Korec, *Definability of arithmetic operations in Pascal triangle modulo an integer divisible by two primes*, ***Grazer Mathematische Berichte***, vol. 318 (1993), pp. 53–62.

[3] S. O. Speranski, *A note on definability in fragments of arithmetic with free unary predicates*, ***Archive for Mathematical Logic***, vol. 52 (2013), no. 5–6, pp. 507–516.

CONTRIBUTED TALKS 26

Friday, 7 August • 4.00PM–6.00PM
Venue - P723

▸ MUSTAFA DEMIRCI, *Heyting duality as an application of fundamental categorical duality theorem.*
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The equivalence **SpatLoc** $\sim$ **SobTop** between the category of spatial locales and the category of sober spaces, its various variants, modifications and generalizations have been a major issue in logic [6], computer science [1] and topology [4, 6] (see also the references in [3]). In order to provide a category-theoretic framework for such variants, starting with an abstract category $\mathbf{C}$, a class $\mathcal{M}$ of $\mathbf{C}$-monomorphisms and a fixed $\mathbf{C}$-object L, a dual adjunction is established between $\mathbf{C}$ and the category $\mathbf{C}$-$\mathcal{M}$-L-**Top** of $\mathbf{C}$-$\mathcal{M}$-L-spaces in [3]. This adjunction restricts to a dual equivalence between the full subcategory of $\mathbf{C}$ of all L-spatial objects and the full subcategory of $\mathbf{C}$-$\mathcal{M}$-L-**Top** of all L-sober objects, which is called Fundamental Categorical Duality Theorem (FCDT for short). FCDT produces many new and familiar dualities such as Stone duality, Priestley duality and the equivalence **SpatLoc** $\sim$ **SobTop**. In other words, FCDT allows us to infer many dualities from just one theorem. The aim of this talk is to add one more case to the list of applications of FCDT, namely Heyting duality [5] (also known as Esakia duality [2]). For this purpose, we elaborate the formulation of FCDT and its basic ingredients, and show how Heyting duality can be deduced from it.

[1] S. Abramsky, A. Jung, *Domain theory*, ***Handbook for Logic in Computer Science, vol. 3*** (S. Abramsky, D.M. Gabbay, T.S.E. Maibaum, editors), Clarendon Press, Oxford, 1994, pp. 1-168.

[2] G. Bezhanishvili and R. Jansana, *Esakia style duality for implicative semi-lattices*, ***Applied Categorical Structures***, vol. 21 (2013), no.2, pp. 181-208.

[3] M. Demirci, *Fundamental duality of abstract categories and its applications*, ***Fuzzy Sets and Systems***, vol. 256 (2014), pp. 73-94.

[4] P.T. Johnstone, ***Stone Spaces***, Cambridge University Press, 1986.

[5] P. J. Morandi, ***Dualities in Lattice Theory***, Mathematical Notes http://sierra.nmsu.edu/morandi/.

[6] S. Vickers, ***Topology via Logic***, Cambridge University Press, 1989.

▸ VLADISLAV NENCHEV, *Effective representation in point-free theories.*
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This is a report that present some results about the development of effective algorithms for representation of *point-free* spatial and spatio-temporal systems. The report also outlines future developments and possible applications of such algorithms.

The systems in question are static and dynamic mereological and mereotopological structures. Mereology and mereotopology are used in Whitehead's programme to rebuild geometry on the base of the notion of *region*, rather than on abstract and unreal notions, like *point* or *line*. Static mereological and mereotopological structures are defined in [1] over Boolean and contact algebras. These structures are relational systems, which feature relations like *part-of*, *overlap*, *underlap* and *contact* (denoted $\leq$, O, U and C). The contact relation C is just the extension of Boolean algebras to contact algebras, while the other three relations are defined with Boolean formulae as follows:

$$x \leq y \overset{\text{def}}{\longleftrightarrow} x.y^* = 0, \quad x \mathsf{O} y \overset{\text{def}}{\longleftrightarrow} x.y \neq 0, \quad x \mathsf{U} y \overset{\text{def}}{\longleftrightarrow} x + y \neq 1.$$

These relations can be used to model space (Geographical Information Systems), computer network topology and (to some extent) groups and coalitions of agents.

[1] also features representation theory for structures with mereological and mereotopological relations, which is a generalization of Stone's representation technique for Boolean algebras. The use of this representation theory, however, is hindered by the fact that the direct realization of the technique leads to exponential complexity. Thus, in order to put the mathematical results into practice, new and more efficient realization of the representation theory is needed. The proposed approach is to view the relational structures as a combination of graphs - $(W, \leq)$, (W, O), (W, U) and (W, C). Thus, it seems possible to reduce the representation to graph-related tasks with complexity $\mathcal{O}(|W|^2)$, $\mathcal{O}(|\leq|)$ or $\mathcal{O}(|\mathsf{O}|)$.

The development of such effective algorithms for representation of mereological and mereotopological structures could lead to reduction of the complexity of tasks for these structures, like logical inference, model-checking, satisfiability or constraint satisfaction. Further goal is to develop similar algorithms for much more complex extensions of these structures presented in [2]. The extensions in question feature temporal (stable and unstable) variants of the mereological and mereotopological relations.

[1] Yavor Nenov and Dimiter Vakarelov, *Modal Logics for Mereotopological Relations*, ***Advances in Modal Logic***, vol. 7, College Publications, 2008, pp. 249–272.

[2] ——— *Dynamic relational mereotopology: Logics for stable and unstable relations.*, ***Logic and Logical Philosophy***, vol. 22 (2013), no. 3, pp. 295–325.

▸ MARIJA BORIČIĆ, *Suppes–style rules for probability logic.*
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We propose an unexpectedly elegant system of probabilistic inference rules enabling to work with the expressions of the form $\Gamma \vdash^n \Delta$, a generalization of Gentzen's sequents $\Gamma \vdash \Delta$ (see [2]), meaning that 'the truthfulness probability of the sequent $\Gamma \vdash \Delta$ is greater than or equal to $1 - n\varepsilon$', for a given small real $\varepsilon > 0$ and any natural number n. For instance, the rules treating implication are as follows:

$$\frac{\Gamma \vdash^n A\Delta \quad \Pi B \vdash^m \Lambda}{\Gamma\Pi A \to B \vdash^{m+n} \Delta\Lambda}(\to\vdash) \qquad \frac{\Gamma A \vdash^n B\Delta}{\Gamma \vdash^n A \to B\Delta}(\vdash\to)$$

and the cut rule:

$$\frac{\Gamma \vdash^n A\Delta \quad \Pi A \vdash^m \Lambda}{\Gamma\Pi \vdash^{m+n} \Delta\Lambda}(\text{cut})$$

These rules are based on Suppes' and Hailperin's ideas (see [3], [7], [8]). Our system, an extension of Gentzen's sequent calculus for classical propositional logic (see [2]), is sound and complete with respect to a kind of Carnap–Popper–Leblanc–type probability logic semantics (see [1], [4], [5], [6]).

[1] R. Carnap, ***Logical Foundations of Probability***, University of Chicago Press, Chicago, 1950.

[2] G. Gentzen, *Untersuchungen über das logische Schliessen*, ***Mathematische Zeitschrift***, vol. 39 (1934–35), pp. 176–210, 405–431, or G. Gentzen, ***Collected Papers***, (ed. M. E. Szabo), North–Holland, Amsterdam, 1969.

[3] T. Hailperin, *Probability logic*, ***Notre Dame Journal of Formal Logic***, vol. 25 (1984), pp. 198–212.

[4] H. Leblanc, B. C. van Fraassen, *On Carnap and Popper probability functions*, ***The Journal of Symbolic Logic***, vol. 44 (1979), pp. 369–373.

[5] H. Leblanc, *Probability functions and their assumption sets — the singular case*, ***Journal of Philosophical Logic***, vol. 12 (1983), pp. 382–402.

[6] K. R. Popper, *Two autonomous axiom systems for the calculus of probabilities*, ***The British Journal for the Philosophy of Science***, vol. 6 (1955), pp. 51–57, 176, 351.

[7] P. Suppes, *Probabilistic inference and the concept of total evidence*, ***Aspects of Inductive Inference***, (J. Hintikka and P. Suppes, editors), North–Holland, Amsterdam, 1966, pp. 49–55.

[8] C. G. Wagner, *Modus tollens probabilized*, ***British Journal for the Philosophy of Science***, vol. 54(4) (2004), pp. 747-753.

▸ DANIELE PORELLO, *Linear Logics of Agency*.
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By extending our previous work in [1], this note presents modal versions of resource-conscious logics. We concentrate on extensions of variants of Linear Logic with one minimal non-normal modality. We start with the language of propositional intuitionistic Linear Logic without the additive disjunction, to which we add a modality. We provide an interpretation of this language on a class of Kripke resource models extended with a neighbourhood function: modal Kripke resource models. We propose a Hilbert style axiomatization and a Gentzen-style sequent calculus. We show that the proof theories are sound and complete with respect to the class of modal Kripke resource models. We show that the sequent calculus allows cut elimination and that proof-search is in PSPACE. We then show how to extend the results when non-commutative connectives are added to the language. In particular, we provide a modal extension of *partially commutative linear logic* [2]. We put the logical framework to use by instantiating it as a logic of agency, that is, we specify the non-normal modality by means of the principles of the logic of *bringing it about* [3]. Finally, we discuss the extensions of our treatment to full linear logic by introducing and studying modal phase models. (This material is based on joint work with Nicolas Troquard).

[1] Daniele Porello and Nicolas Troquard, *A resource-sensitve logic of agency*, ***In Proceedings of the 21st European Conference on Artificial Intelligence (ECAI'14), Prague, Czech Republic. 2014***

[2] Philippe De Groote, *Partially commutative linear logic: sequent calculus and phase semantics.*, ***In Third Roma Workshop: Proofs and Linguistics CategoriesApplications of Logic to the analysis and implementation of Natural Language, pages 199208, 1996.***

[3] Dag Elgesem, *The modal logic of agency*, ***Nordic J. Philos. Logic, 2(2), 1997.***

▸ LUCA TRANCHINI, *A proof-theoretic criterion of synonymy and the distinction between intensional and extensional harmony*.
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A central concept of proof-theoretic semantics is the one of harmony, a condition that the rules for a logical connective have to satisfy in order to endow the connective with an acceptable meaning. In the natural deduction setting harmony is explained via the inversion principle, a recipe to generate a collection of elimination rules for a connective from a given collection of introduction rules for that connective.

I will draw the attention to the fact that many advocates of the inversion principle implicitly adopt a notion of equivalence between rules. Only together with a notion of equivalence does the inversion principle yield a thorough account of harmony. The reason is that the elimination rules generated by inversion are not the only elimination rules in harmony with a given collection of introduction rules. Intuitively, any collection of elimination rules equivalent (i.e. interderivable) with the one generated by inversion will also be in harmony with the given collection of introduction rules.

By considering some examples, I will show that this picture yields a notion of meaning which is too much "extensional" since on such an account any two interderivable complex sentence are treated as synonymous. I will then suggest that in order to attain a more intensional account, one should abandon the notion of equivalence in favour of a more stricter notion, to be modeled upon the one of formula isomorphism from lambda calculus and category theory.

CONTRIBUTED TALKS 27

Friday, 7 August • 4.00PM–6.00PM
Venue - P724

▸ OVIDIU COSTIN, PHILIP EHRLICH, *INTEGRATION ON THE SURREALS: A CONJECTURE OF CONWAY, KRUSKAL AND NORTON*.
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In his monograph *On Numbers and Games* [1], J. H. Conway introduced a real–closed field **No** of *surreal numbers* containing the reals and the ordinals, as well as a vast array of less familiar numbers including $-\omega$, $1/\omega$, $\sqrt{\omega}$ and $\ln\omega$ to name only a few. A longstanding aim has been to develop analysis on **No** as a powerful extension of ordinary analysis on $\mathbb{R}$. This entails finding a natural way of extending important functions $f : \mathbb{R} \to \mathbb{R}$ to functions $f^* : \mathbf{No} \to \mathbf{No}$, and naturally defining integration on the f^*. The usual square root, $\log : \mathbb{R} \to \mathbb{R}$, and $\exp : \mathbb{R} \to \mathbb{R}$ were naturally extended to **No** by Bach, Conway, Kruskal, and Norton, retaining their usual properties. Later Norton also proposed a treatment of integration, but Kruskal discovered flaws. In his recent survey [2, p. 438], Siegel characterizes the question of the existence of a reasonable definition of surreal integration as "perhaps the most important open problem in the theory of surreal numbers." This paper, which is joint work with Harvey Friedman and the authors, addresses this and related unresolved issues with positive and negative results. In the positive direction, we show that semi-algebraic, semi-analytic, analytic, meromorphic, or more generally Écalle-Borel transseriable functions extend naturally to **No**, and an integral with good properties exists on them. In the negative direction, we show there is a fundamental set theoretic obstruction to naturally extending many larger families of functions.

[1] J. H. Conway, **On Numbers and Games**, *Academic Press*, 1976.

[2] A. Siegel, **Combinatorial Game Theory**, *American Mathematical Society*, 2013.

▸ AIBAT YESHKEYEV, *Properties of central type for fragments of Jonsson sets*.
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This abstract is devoted to the study of the concept of Jonsson sets in countable signature σ and its application.

Let T is a complete for existential sentences perfect Jonsson theory [1], C is the semantic model of theory T. T^* is a center of theory T and $T^* = Th(C)$. Let X Jonsson set [2] and M is existentially closed model with dcl(X)=M. We consider $Th_{\forall\exists}(M) = T_M$ and T_M will be a fragment of X.

Consider all completions of theory T^* in the new signature σ_Γ, where $\Gamma = \{P\} \cup \{c\}$,

P is unary predicate, c is some new constant symbol. Due that T^* will be Jonsson theory and in the new signature, so theory T^* has a center which we denote by T^c. When we restricted us to the language of the signature $\sigma \cup P$, theory T^c becomes a complete type. This type we call as central type of the theory T.

Since $M \subseteq C$, we can consider also all completions for T_M in σ_Γ. And we have that T_M also is Jonsson theory and let T_M^* will be its a center, then when we consider central type $(T_M^*)^C$ of this fragment one can note that this fragment closely related with respect to the model-theoretic properties with the Jonsson theory T.

In this part of the abstract we wanted to reflect the results of the relationship between the central type and the fragment of fixing Jonsson set. For example, if such type is definable if only if the fragment is stable in Jonsson meaning [1].

In addition to the stability were considered questions about the relationship of the central type and the fragment of a certain Jonsson set associated with the categoricity and the syntactic similarity.

Let us recall the definition of the convex theory belonging to A.Robinson ([3], p.80). T is convex if for any model A of T and any collection $\{B_i : i \in I\}$ of substructures of A which are models of T, intersection $\bigcap_{i\in I} B_i$ is a model of T, provided it is non-empty.

The theory T will be called existentially prime if the intersection of the class of existentially closed models and the class of algebraically prime models is non-empty, assuming that the theory T has at least one algebraically prime model.

In the second part of our abstract we will have deal with the question on relationship between the algebraically primeness [4] and some kind of the atomicity [4] of the model.

Were found syntactic (some kind of atomic models) and semantic (algebraically primeness of the model) the conditions and equivalence of this conditions for the existential simple convex fragments of some Jonsson set.

[1] Yeshkeyev A.R., ***Jonsson Theories***, Publisher of the Karaganda state university, 2009.

[2] Aibat Yeshkeyev, *On Jonsson sets and some their properties*, ***Abstract Booklet of Logic Colloquium*** (Vienna Summer of Logic), 2014, pp. 108–109.

[3] Robinson A., ***Introduction to Model Theory and to the Metamathematics of Algebra***, Amsterdam, 1963.

[4] Baldwin J.T., Kueker D.W., *Algebraically prime models*, ***Ann. Math. Logic***, no. 20, pp. 289–330.

▸ CAROLINE TERRY, *Zero-one laws for edge weighted graphs*.
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Fix integers s, q, and r, and define $\mathcal{L}_s = \{R_1, \ldots, R_r\}$ to be the language consisting of s binary relation symbols. For each $n \in \mathbb{N}$, define $F_{s,q,r}(n)$ to be the set of $\mathcal{L}_s$-structures with universe $[n] = \{1, \ldots, n\}$ such that each R_i is symmetric and irreflexive, and such that for any set of s points $X \subseteq [n]$, $\sum_{x\neq y\in X} |\{i : R_i(x, y)\}| \leq q$. We present results on the approximate asymptotic structure of $F_{s,q,r}(n)$ for various values of s, q, and r. In special cases of s, q, and r we refine these results to yield a logical 0-1 law. These results generalize existing 0-1 laws for the families of finite K_n-free graphs for $n \geq 3$. This is joint work with Dhruv Mubayi.

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Several authors have conjectured that Conway's field of surreal numbers, equipped with the exponential function of Kruskal and Gonshor, can be described as a field of transseries and admits a compatible differential structure of Hardy-type. In this paper we give a complete positive solution to both problems. We also show that with this new differential structure, the surreal numbers are Liouville closed, namely the derivation is surjective.

[1] Alessandro Berarducci, Vincenzo Luca Mantova, *Surreal numbers, derivations and transseries*, ***ArXive 1503.00315***, (2015), pp. 1–46.

▸ AIDA ALIBEK, BEKTUR BAIZHANOV, JOHN BALDWIN, AISHA YERSHIGESHOVA, AND TATYANA ZAMBARNAYA, *Diagrams and small theories*.
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In this work we consider the notions of finite diagrams and small theories towards a new approach to the Vaught conjecture. In particular, if theory T is a counterexample to Vaught's conjecture then there is a diagram $D(M)$ with uncountably many countable models N, such that $D(N) = D(M)$ (Baizhanov-Zambarnaya).

Based on the work of Baizhanov-Yershigeshova, constructing such a family of diagrams represents a special interest. Given a finite diagram Δ in S(T) with $\aleph_1$ non-homogenous models, one can build a new diagram Δ' in S(T) also with $\aleph_1$ non-homogenous models.

[1] B.S. Baizhanov, B. Omarov, *On finite diagrams*, ***Teorija reguljarnyh krivyh v razlichnyh geometricheskih prostranstvah*** KazGU, Almaty, Kazakhstan 1979, pp. 11–15.

[2] B.S. Baizhanov, N. Tazabekova, A. Yershigeshova, T. Zambarnaya, *Types in small theories*, ***Mathematical Journal***, vol. 15 (2015), no. 1(55), pp. 38–56.

[3] S. Shelah, *Finite diagrams stable in power*, ***Annals of Mathematical Logic***, vol. 2 (1970), no. 1, pp. 69–118.

▸ BRICE HALIMI, *Homotopy Model Theory*.
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"Homotopy Type Theory" connects logic with homotopy theory through type theory. The purpose of this paper is to connect logic with homotopy theory through model theory.

Given a first-order language L with equality, supposed to contain a unary quantifier Q, let F_n be the set of formulas of L with exactly $v_0, \ldots, v_n$ as free variables. The two following applications $d_i : F_n \to F_{n-1}$ (for $n \geq 1$) and $s_i : F_n \to F_{n+1}$ can then be defined:

$d_i(\phi(v_0, \dots, v_n)) = Qx\ \phi(v_0, \dots, v_{i-1}, x, v_i, \dots, v_{n-1})$
$s_j(\phi(v_0, \dots, v_n)) = ((v_j = v_{j+1}) \to \phi(v_0, \dots, v_{j-1}, v_{j+1}, \dots, v_{n+1}))$.

Up to logical equivalence, these maps satisfy a set of equalities called "simplicial identities,", so that $F_*^Q = \langle F_n, (d_i^n)_{0 \le i \le n}, (s_j^n)_{0 \le j \le n} \rangle_{n \in \mathbb{N}}$ is a *simplicial set*. So Q can be compared to a "face operator," while (s_j) is the corresponding sequence of "degeneracy operators." The *boundary* of a given formula ϕ can then be defined as follows:

$\partial\phi := \bigwedge_{i=0}^{n-1} \neg^i \forall x \phi(v_0, \dots, v_{i-1}, x, v_{i+1}, \dots, v_{n-1})$.

This prompts a comparison pointing to homotopy theory.

For any L-structure M, with $Q = \exists$, consider
$M_* = F_*^{\exists, M} = \langle D_n(M), (\exists_i^{n,M})_{0 \le i \le n}, (s_j^{n,M})_{0 \le j \le n} \rangle_{n \in \mathbb{N}}$,
where $D_n(M)$ (for $n \ge 0$) is the set of all definable subsets of $|M|^{n+1}$, where $\exists_i^{n,M}$: $D_n(M) \to D_{n-1}(M))$ are the natural existential projections, and where $s_j^{n,M} : D_n(M) \to D_{n+1}(M)$ are the corresponding degeneracy operators. The resulting M_* is a simplicial set.

Theorem 1. *A substructure M of a L-structure N is an elementary substructure of N iff the corresponding restriction $r_* : N_* \to M_*$ is a simplicial map.*

Corollary 2. *The mapping $(-)_*$ is a contravariant functor from the category of L-structures and elementary embeddings, to the category of simplicial sets and simplicial maps.*

Theorem 3. *Let M be an elementary substructure of N. Then M_* is a retract of N_* iff the domain $|M|$ of M is definable in N.*

Other results are reached, in particular about spaces of types, that lead to the comparison of the definition of a type with a boundary operator (in the sense of a chain complex).

BY TITLE ONLY

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Following Tarski's practice [3, pp. 152–278, 409–420], we assume interpreted formalized languages. As usual, a *deduction* is a rule-governed list of sentences beginning with premises and ending with a *conclusion*—usually including other intermediate sentences also. A system of deductions is *truth-preserving* if each of its deductions having true premises has a true conclusion [3, p. 167]—*implication-preserving* if, for any sentence set, each deduction having premises that are implications of that set has a conclusion that is an implication of that set [2, p. 15]—and *cogent* or *cognition-preserving* if, for any sentence set, each deduction having premises that are known to be implications of that set produces knowledge that its conclusion is an implication of that set.

Every implication-preserving system is truth-preserving. It is well-known that the converse fails: not every truth-preserving system is implication-preserving [2, Appendix]. Consider first-order Peano-Arithmetic, from a certain two tautological premises the induction rule yields 'for every number x: x is zero or x is a successor'—which is *not* an implication of the null set. See this Bulletin, vol. 20 (2014), pp. 130–1.

Every cognition-preserving system is implication-preserving. It is easily seen that the converse fails: not every implication-preserving system is cognition-preserving [2, Appendix]. Consider the system having only one rule: From any premise deduce any of its implications. Implication-preserving systems not cognition-preserving are unacceptable to persons espousing traditional truth-and-consequence conceptions of demonstration [2, p. 16] [1, §4.1]: a demonstration shows its conclusion is true by showing that its conclusion is a *consequence* of premises already known to be *true*.

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[2] ———, *Founding of logic*, ***Ancient Philosophy***, vol. 14 (1994), pp. 9–24.
[3] Alfred Tarski, ***Logic, semantics, metamathematics***, Hackett, 1983.

▸ JOHN CORCORAN AND IDRIS SAMAWI HAMID, *Two-method errors: having it both ways.*

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Where two methods produce similar results, mixing the two sometimes creates errors we call *two-method errors*, TMEs: in style, syntax, semantics, pragmatics, implicature, logic, or action. This lecture analyzes logically relevant examples found in technical and in non-technical contexts.

One can say "Abe knows whether Ben draws" in two other ways: 'Abe knows whether or not Ben draws' or 'Abe knows whether Ben draws or not'. But a *stylistic* TME occurs in 'Abe knows whether or not Ben draws or not'.

One can say "Abe knows how Ben looks" using 'Abe knows what Ben looks like'. But *syntactical* TMEs are in 'Abe knows what Ben looks' and in 'Abe knows how Ben looks like'.

One can deny that Abe knows Ben by prefixing 'It isn't that' or by interpolating 'doesn't'. But a *pragmatic* TME occurs in trying to deny that Abe knows Ben by using 'It isn't that Abe doesn't know Ben'.

There are several standard ways of defining truth using sequences. Quine's discussions in the 1970 first printing of ***Philosophy of logic*** [3] and in previous lectures were vitiated by mixing two [1, p. 98]. The *logical* TME in [3], which eluded Quine's colleagues, was corrected in the 1978 sixth printing [2]. But Quine never explicitly acknowledged, described, or even mentioned the error.

This lecture presents and analyses two-method errors in the logic literature.

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[2] ———, *Review of sixth printing of Quine's 1970* ***Philosophy of logic***, ***Mathematical Reviews*** MR0469684, vol. 57 (1979), no. 9465.

[3] Willard Van Orman Quine, ***Philosophy of logic***, Harvard, 1970/1986.

▸ CYRUS F NOURANI, *On model categories and types.*
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Considering the new developments since the author's 1995-2000 publications let us examine how we can present model categories, for example, starting with a Martin-Löf types. The $D < A, G >$ category is the category for models definable with $D < A, G >$ and their morphisms. The techniques we are presenting by the three categories are newer techniques. An example computing view to the functorial models was presented by defining Hasse diagrams on the $L_{\omega 1,K}$ fragments at ASL Münster several years ago. The limit model is defined by computing Hasse diagram limits and natural transformations on the limit cones.

Objects $L_{\omega 1,K}$ Models definable with $D < A, G >$; Morphisms: $H :< h : M \to M' >$, where h is a model homomorphism. Let us carry on with the fragment $L_{\omega 1,K}$ for the time being. Let ML- denote a Martin-Löf Type system with constructors Π and Σ.

Definition A generic $L_{\omega 1,K}$ ML-diagram is a diagram ML-definable on $L_{\omega 1,K}$.

Theorem 1 There is a generic model functor that creates a ML $D < A, G >$ model.

Proof Follows from the generic model theorems, the initial model theorem on $D < A, G >$ and ML definability, generic functorial Models and Topos.

Theorem 2 The generic $D < A, G >$ model is a model category for the ML-types $L_{\omega 1,K}$ definable.

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The 1969 paper, "Three logical theories" [1], considers three logical systems all based on the same interpreted language and having the same semantics.

The first, a *logistic system* LS, codifies tautologies (logical truths)—using tautological axioms and tautology-preserving rules that are not required to be consequence-preserving.

The second, a *consequence system* CS, codifies valid premise-conclusion arguments—using tautological axioms and consequence-preserving rules that are not required to be cogency-preserving [2]. A rule is *cogency-preserving* if, roughly, in every application, the conclusion is known to follow from its immediate premises if those immediate premises are all known to follow from their respective immediate premises.

The third, a *deductive system* DS, codifies deductions, or cogent argumentations [2]—using cogency-preserving rules. The derivations in a DS represent deduction: the process by which conclusions are deduced from premises, i.e., the way knowledge of argument-validity is achieved in practice. Thus, deductive systems are all natural-deduction systems in the strict intuitive sense.

The 1969 paper presupposed audiences that accept deductive systems—natural-deduction—as epistemically fundamental and that regard logistic systems and consequence systems as technically sound but artificial constructs. However, this paper aims for wider audiences including logicians who regard logistic or consequence systems as epistemically fundamental and who take natural-deduction to be "psychological", "heuristic", or in some other way scientifically inferior, derivative, or even inadequate.

Moreover, this paper also discusses epistemic foundations. How do proponents of logistic systems explain how knowledge of tautologousness is acquired? How do proponents of consequence systems explain how knowledge of consequence-preservation is acquired? How do proponents of deductive systems explain how knowledge of cogency-preservation is acquired?

[1] John Corcoran, *Three logical theories*, ***Philosophy of Science***, vol. 36 (1969), pp. 153–177.

[2] ———, *Argumentations and logic*, ***Argumentation***, vol. 3 (1989), pp. 17–43.

▸ JOSÉ M. MÉNDEZ, GEMMA ROBLES, FRANCISCO SALTO, *Slaney's matrix for Anderson and Belnap's First Degree Entailment Logic.*
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Sometime around the late sixties of the past century, T. Smiley communicated (in correspondence) to Anderson and Belnap a set of truth tables that conform what we shall name Smiley's matrix MSm4 (cf. [1], p. 161). Anderson and Belnap proved that MSm4 is characteristic for (i.e., determines) First Degree Entailment Logic, FDE (cf. [1], pp. 161-162). The aim of this paper is to investigate which logic is characterized by MSm4 if we go beyond first degree entailments to nested entailments. It will be shown that it is an interesting 4-valued logic in the vicinity of Lewis' modal logic S4.

[1] A. R. Anderson, N. D. Jr. Belnap, ***Entailment. The logic of relevance and Necessity***, vol. 1, Princeton University Press, 1975.

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▸ GEMMA ROBLES, *A 4-valued logic without Łukasiewicz type paradoxes.*
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Łukasiewicz presented two different analyses of modal notions by means of many-valued logics: (1) the linearly ordered systems Ł3, ...,Łn, ...,Łω; (2) the 4-valued logic Ł defined in the last years of his career. Unfortunately, all these systems contain "Łukasiewicz type (modal) paradoxes" such as $\Diamond A \wedge \Diamond B \to .\Diamond(A \wedge B)$ or $\Box(A \vee$

$B) \to .\Box A \vee \Box B$. The aim of this paper is to define a 4-valued modal logic lacking Łukasiewicz type (modal) paradoxes. In order to do this, we shall build a modal expansion of Brady's 4-valued paraconsistent logic BN4, which can be considered as the basic bilattice logic. This modal expansion of BN4 is defined following Łukasiewicz's strategy for constructing truth-functional modal logics.

[1] O. Arieli, A. Avron, *Reasoning with logical bilattices*, ***Journal of Logic, Language and Information***, 5 (1996), pp. 25-63.
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[3] J. Łukasiewicz , ***Selected works***, North-Holland, Amsterdam, 1970.
Acknowledgements. - Work supported by research project FFI2014-53919-P, financed by the Spanish Ministry of Economy and Competitiveness. - G. Robles is supported by Program Ramón y Cajal of the Spanish Ministry of Economy and Competitiveness.

▸ T. J. STĘPIEŃ, Ł. T. STĘPIEŃ, *The Formalization of the Arithmetic System on the Ground of the Atomic Logic.*
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1. Terminology. Let $\to, \sim, \vee, \wedge, \equiv$ denote the connectives of implication, negation, disjunction, conjunction and equivalence, respectively. Next, $At_0 = \{p, p_1, p_2, ...\}$ denotes the set of all propositional variables. S_0 is the set of all well-formed formulas, which are built in the usual manner from propositional variables by means of logical connectives. We use $\Rightarrow, \neg, \mathbb{V}, \&, \Leftrightarrow, \forall, \exists$ as metalogical symbols. $E(\mathfrak{M})$ denotes the set of all formulas valid in the matrix $\mathfrak{M}$. S_1 is the set of all well-formed formulas of predicate calculus. $P_i^k(t_1, ..., t_k)$ is a simple formula, where $t_1, ..., t_k$ are terms. $\bigwedge_{x_k}, \bigvee_{x_k}$ are quantifiers. R_{S_1} denotes the set of all rules over S_1. $Cn_1(R, X)$ is the smallest subset of S_1, containing X and closed under the rules R. $\langle R, X\rangle$ is called a system, whenever $R \subseteq R_{S_1}$ and $X \subseteq S_1$. r_o, r_+ denote Modus Ponens and generalization rule in the predicate calculus and $\{r_o, r_+\} = R_{o+}$. L_2 is the set of all formulas valid in the classical predicate calculus. <u>Definition 1.1.</u> The function $j : S_1 \longrightarrow S_0$, is defined, as follows: $j(P_k^n(t_1, ..., t_n)) = p_k(p_k \in At_0)$, $j(\sim \phi) = \sim j(\phi)$, $j(\phi F \psi) = j(\phi) F j(\psi)$, $j(\bigwedge_{x_k} \phi) = j(\bigvee_{x_k} \phi) = j(\phi)$, where $F \in \{\to, \vee, \wedge, \equiv\}$ and $\phi, \psi \in S_1$. Matrix $\mathfrak{M}_D = \langle\{0, 1, 2\}, \{1, 2\}, f_D^{\to}, f_D^{\equiv}, f_D^{\vee}, f_D^{\wedge}, f_D^{\sim}\rangle$ is defined, as follows [4]:

$f_D^{\to}$	0	1	2
0	1	1	1
1	0	1	0
2	0	1	2

$f_D^{\equiv}$	0	1	2
0	1	0	0
1	0	1	0
2	0	0	2

$f_D^{\vee}$	0	1	2
0	0	1	0
1	1	1	1
2	0	1	2

$f_D^{\wedge}$	0	1	2
0	0	0	0
1	0	1	1
2	0	1	2

$f_D^{\sim}$	
0	1
1	0
2	2

2. Atomic Logic
<u>Definition 2.1.</u> $L_D = \{\phi \in S_1 : j(\phi) \in E(\mathfrak{M}_D)\ \&\ \phi \in L_2\}$.
In [4] (see also [3]) we have proved:
<u>Theorem 2.2.</u> The system $\langle R_{o+}, L_D\rangle$ is based on the atomic entailment.

3. The main result
$R_{o+}^P = \{r_o^P, r_+^P\}$, where r_o^P, r_+^P are respectively: Modus Ponens and generalization rule in the Arithmetic System and L_2^r is the set of all classical logical axioms in the Arithmetic System (see [2]). The function $i : S_A \longrightarrow S_0$ is defined analogically, as the function $j : S_1 \longrightarrow S_0$, where S_A is the set of all well-formed formulas in the Arithmetic System. $Pr(\phi)$ denotes the set of all predicate letters occuring in ϕ, where $\phi \in S_A$. Sx denotes the successor of x. Let $\psi^{12} = \bigwedge_{x_1} \bigwedge_{x_2} [\bigvee_{x_3} (x_1 + x_3 = x_2) \equiv (x_1 < x_2)]$ and $\psi^{14} = \bigwedge_{x_1} \bigwedge_{x_2} [\bigvee_{x_3} (Sx_3 + x_1 = x_2) \equiv (x_1 < x_2)]$.

<u>Definition 3.1.</u> $L_D^r = \{\phi \in L_2^r : i(\phi) \in E(\mathfrak{M}_D)\}$.

Thus,

<u>Theorem 3.2.</u> If $\langle R_{o+}^P, L_2^r \cup A_r\rangle$ is the Arithmetic System and $\psi^{12} \in A_r$ or $\psi^{14} \in A_r$ and $(\forall \phi \in L_2^r \cup A_r)[Pr(\phi) \subseteq \{=, <\}]$, then $Cn(R_{o+}^P, L_D^r \cup A_r) = Cn(R_{o+}^P, L_2^r \cup A_r)$.

Hence,

Conclusion. The Atomic Logic establishes the necessary and sufficient condition of relevance. Next, the Atomic Logic suffices for the formalization of classical Arithmetic (cf. [1] p. 531).

[1] B. Buldt, "The Scope of Gödel's First Incompleteness Theorem", *Log. Univ.*, **8**, 499 - 552 (2014).
[2] H. Rasiowa, "Introduction to Modern Mathematics", North-Holland Publishing Company, 1973.
[3] T. J. Stępień and Ł. T. Stępień, "Atomic Entailment and Classical Entailment", *The Bull. Symb. Logic*, **17**, 317-318 (2011).
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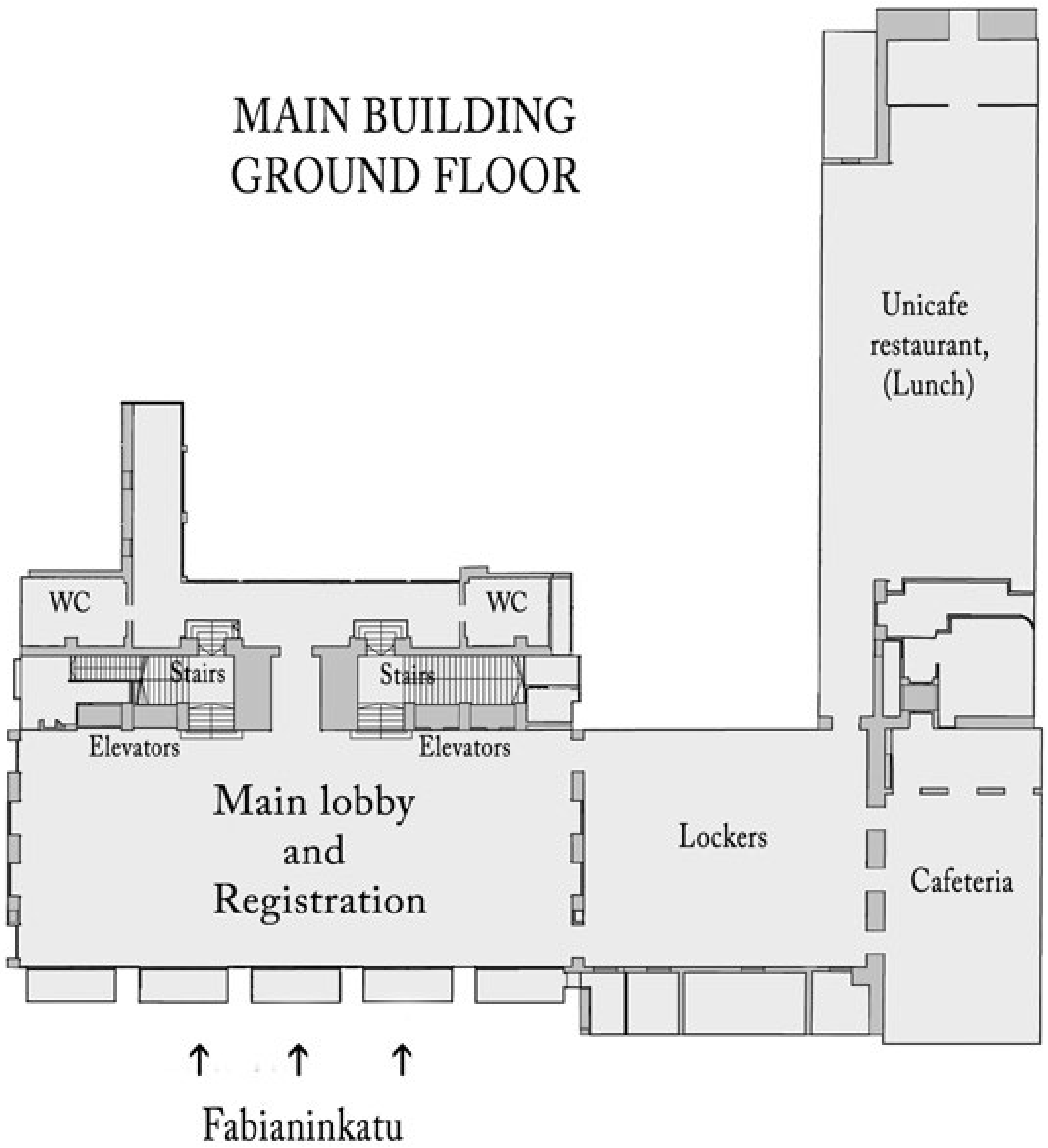
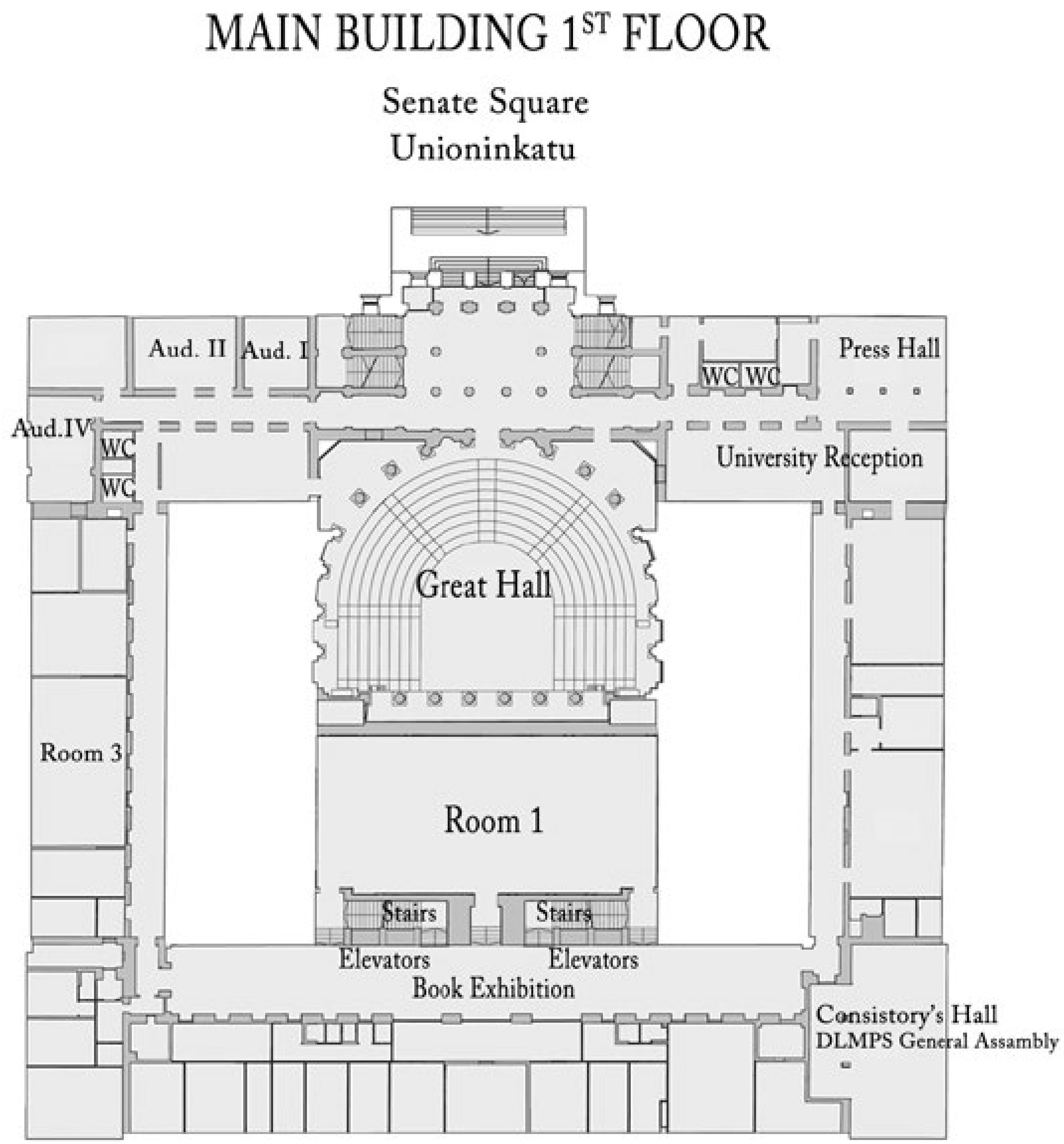
MAPS

MAIN BUILDING





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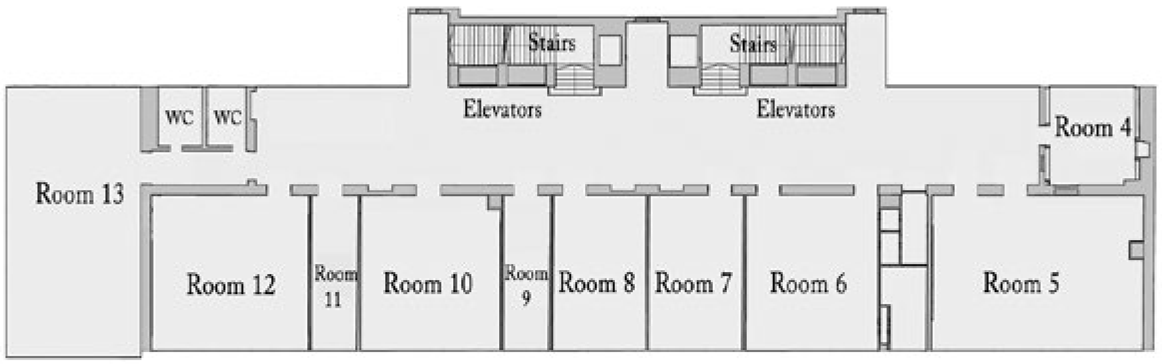

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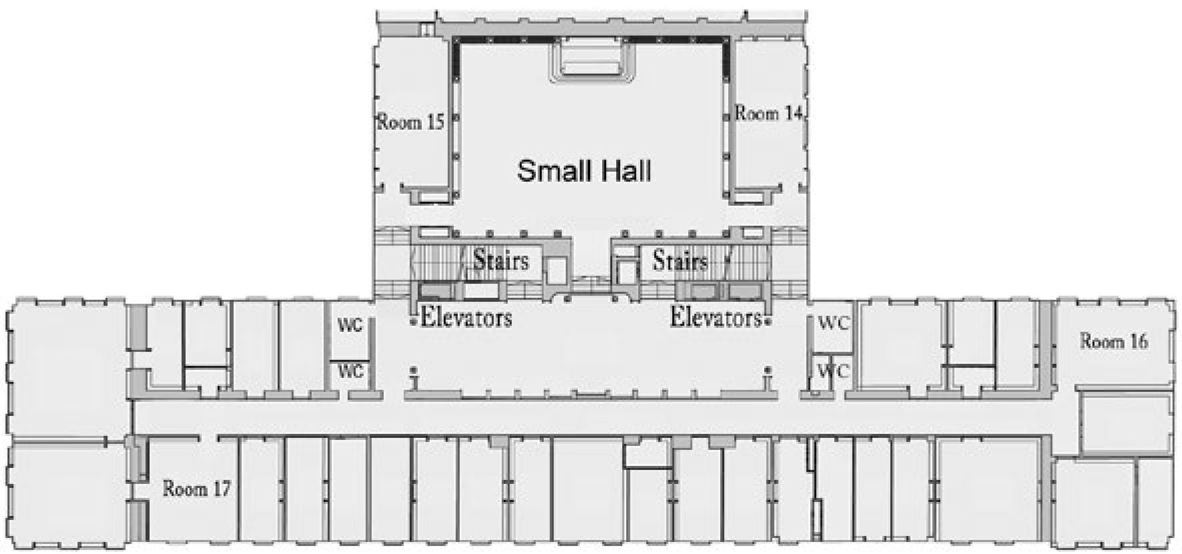
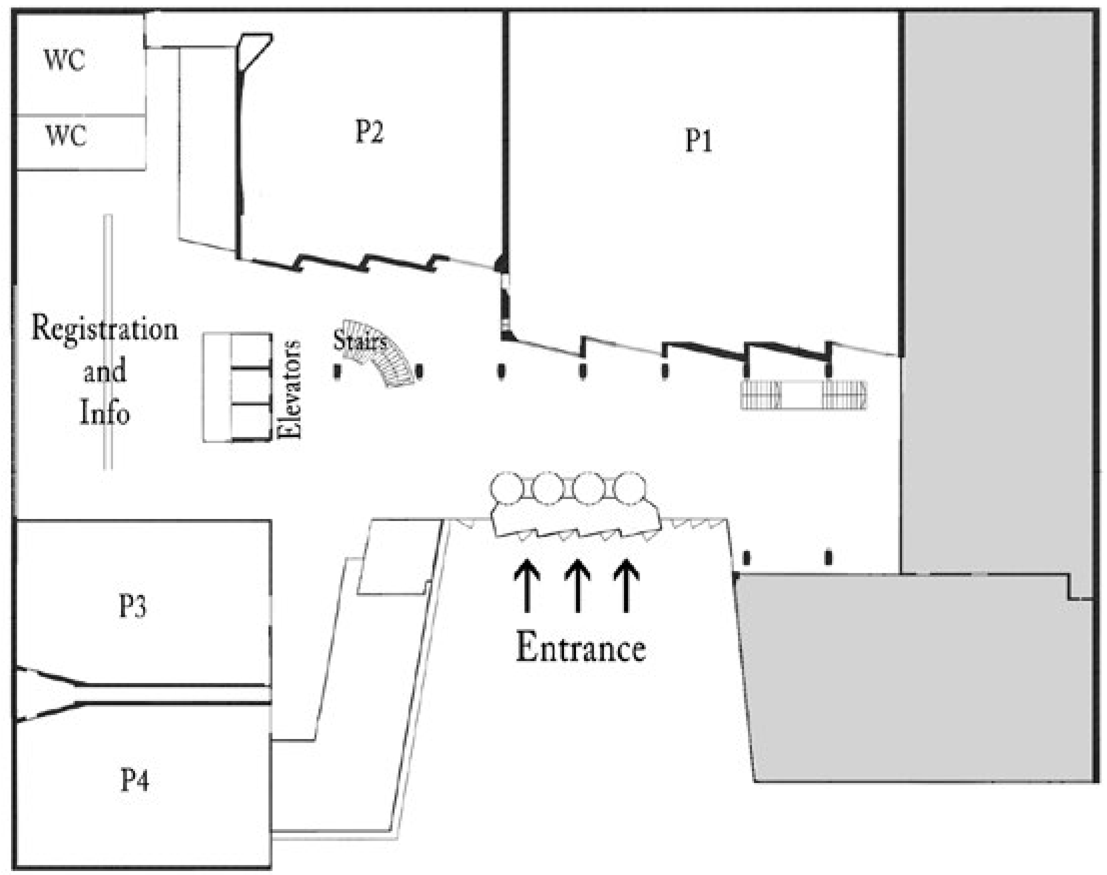
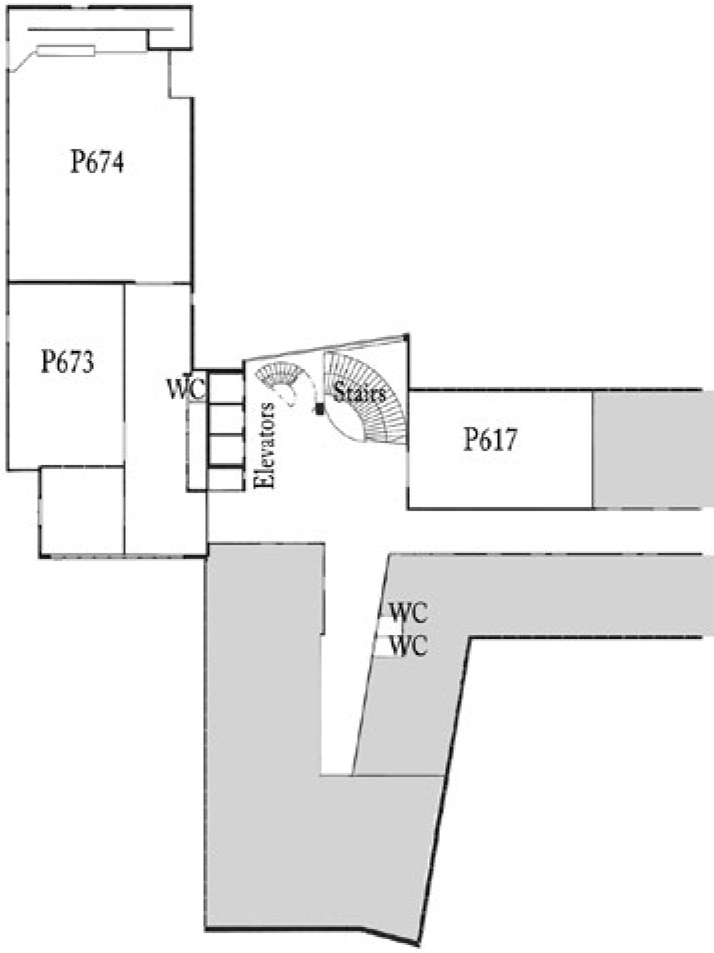


PORTHANIA

PORTHANIA GROUND FLOOR



PORTHANIA 6TH FLOOR



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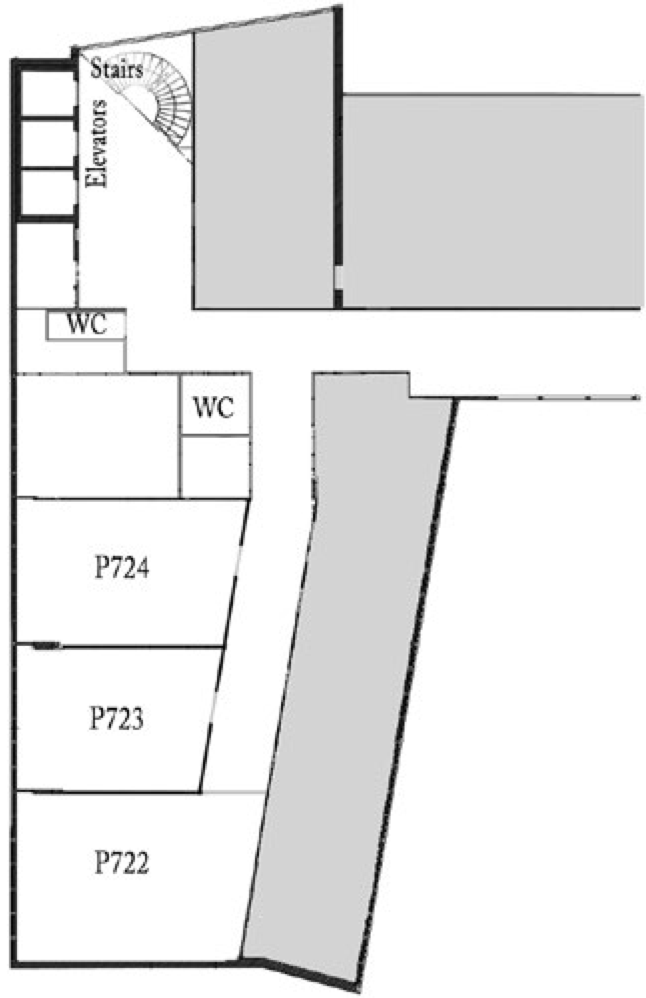
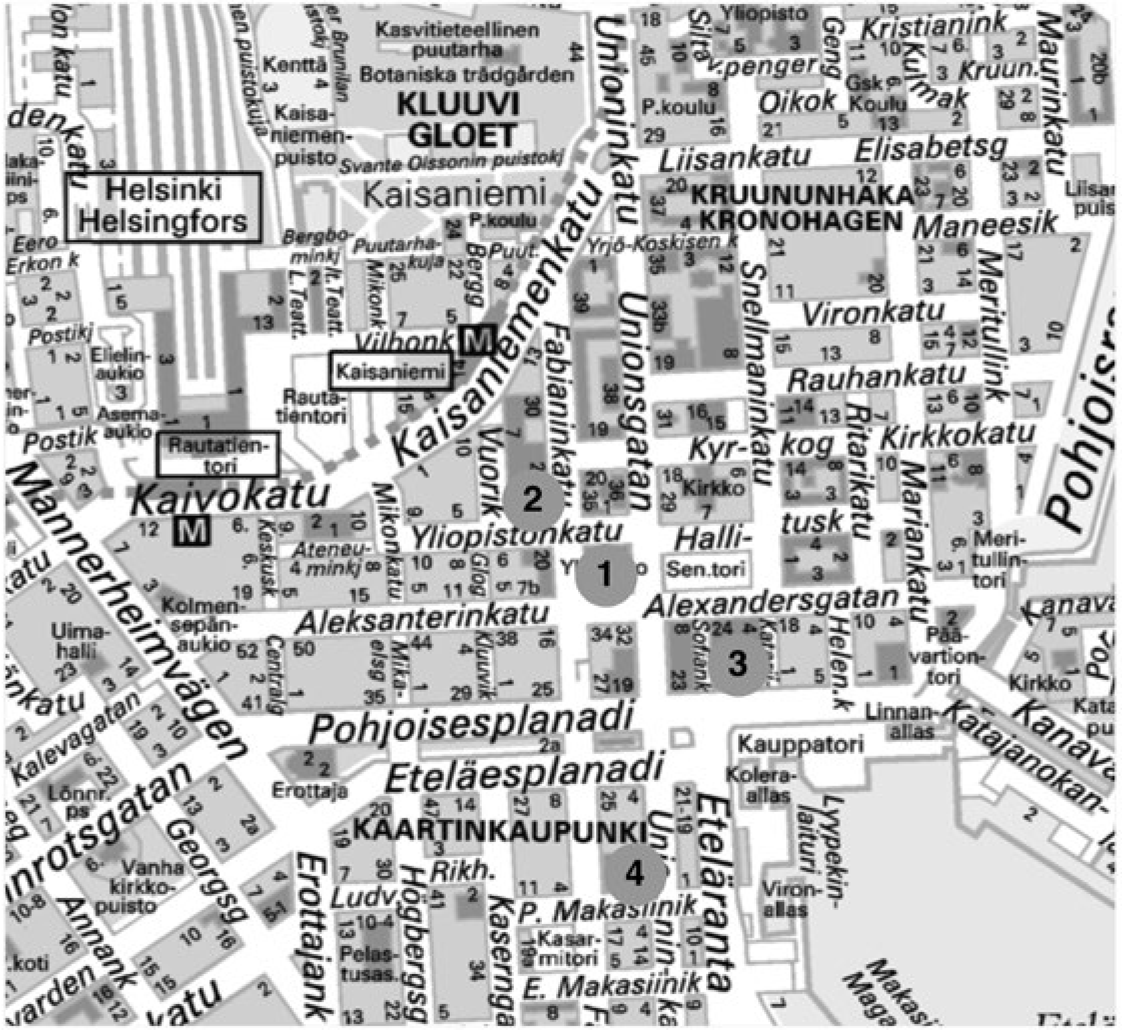


CLMPS 2015 & LC 2015 CAMPUS MAP



(1) Main Building of the University of Helsinki (Fabianinkatu 33): CLMPS 2015 venue and student restaurant Unicafe Main Building (Lunch)

(2) Porthania Building (Yliopistonkatu 3): Logic Colloquium 2015 venue

(3) City Hall (Pohjoisesplanadi 11-13): Reception in the banquet room at 18:30 on Wednesday.

(4) Restaurant Bank (Unioninkatu 20) Congress Dinner on Friday at 19.30

THE LOGICAL STRUCTURE OF CORRELATED INFORMATION CHANGE (LOGICIC)

Wednesday, August 5 • 09:00 - 10:50 (Pacuit, Kuipers, Shi, Fitelson, Kelly, Christoff)
Wednesday, August 5 • 14:30 - 16:20 (Kuipers, Roy, Smets, Kelly, Baltag, Rad)
Wednesday, August 5 • 16:40 - 18:30 (Baltag, Fitelson, Galeazzi, Roy, Pacuit, Smets)
Main Building, Room 7

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B. AIM AND SCOPE

This affiliated meeting is devoted to the LogiCIC Research Project on "The Logical Structure of Correlated Information Change". One of the central topics of the LogiCIC Research Project deals with logical approaches to rational belief revision. In this context we study different formal representations of doxastic and epistemic attitudes as well as their dynamics. On the static side, we look at formal models of belief and knowledge and pay special attention to notions such as coherence, justification and the evidential-basis of beliefs. On the dynamic side, we center the discussion on belief revision and knowledge updates, focusing in particular on strategies for learning and truth convergence. The latter topic of investigation can benefit from the formal study of scientific theory change and issues of approximation and verisimilitude. Hence in line with the methodology of the LogiCIC project, we approach the topic of 'rational belief revision' from an interdisciplinary angle by bringing together researchers in philosophical logic, formal epistemology, formal learning theory and truth approximation theory. This meeting creates a platform at which the latest developments can be presented and discussed. We look both at already-established conceptual theoretical work as well as the possible new connections that can emerge between the areas of logic, belief revision theory, learning theory and truth approximation theory.

The LogiCIC project (ERC-2011-STG No. 283963) is funded by the European Research Council and the European Community under FP7.

This meeting is sponsored by the LogiCIC project and by FoLLI, The Association for Logic, Language and Information

C. ABSTRACTS

From Degrees of Belief to Probable Knowledge: a Bayesian framework for defeasibility theory.

Baltag Alexandru
University of Amsterdam, NETHERLANDS

I propose a probabilistic version of the so-called defeasibility theory of knowledge. A proposition P is undefeated iff its degree of belief stays high (above a fixed threshold) when any true information is learnt. This is a quantitative version of the "robustness"' or stability requirement that underlies the defeasibility theory. Undefeated belief is a factive attitude, but is not (positively) introspective, nor even additive (both P and Q can be undefeated without their conjunction being so). However, there is a "reflexive" version of this notion, that seems apt as a formalization of "conscious knowledge", and is given by a circular definition: P is known iff both P and the fact that P is known are undefeated. The resulting theory fits well with the latest developments in Bayesianism: its relationship with Leitgeb's "stability theory of belief" is similar to the relationship between the usual (qualitative) notion of defeasible knowledge and the AGM theory of belief revision. Time-permitting, I show that only minimal assumptions about probability are in fact needed (namely, de Finetti's axioms of comparative probability minus the totality axiom).

Epistemic Utility Theory: Static and Dynamic constraints on rational belief.

Fitelson Branden
Rutgers University, UNITED STATES

In this talk, I will explain how epistemic utility theory can be used to provide a unified derivation of both static and dynamic constraints on rational belief (and its revision).

Ockham's Razor as Belief Revision

Kelly Kevin T.
Carnegie Mellon University, UNITED STATES
Genin Konstantin
Carnegie Mellon University, UNITED STATES

Belief revision theory proposes norms for belief change in light of new information. The standard procedure is to rank possibilities by "entrenchment" and to revise to the most entrenched possibilities compatible with current experience. Science revises its theories. The driving factor is often empirical simplicity, which is associated with free parameters, testability, unity, and explanatory power. So it is very natural to think of scientific theory choice as belief revision in which entrenchment is interpreted as simplicity. We will address the following questions. What is simplicity? Given simplicity, what kind of belief revision operation is Ockham's razor? And finally, in what sense is Ockham's razor more truth-conducive than other strategies? Our approach is based on ideas from topology, descriptive set theory, and, surprisingly, algebraic geometry.

Concretizations of two-sided nomic truth approximation

Kuipers Theo A. F.
University of Groningen, NETHERLANDS

In a recent paper, entitled "On the generalization of nomic truth approximation to theories consisting of models and postulates" I have shown that nomic truth approximation can perfectly be achieved by combining two *prima facie* opposing views on theories:

The traditional view(s): theories are sets of (models satisfying) postulates that exclude certain possibilities from being realizable.

The model view: theories are sets of models that claim to represent certain realizable possibilities, at least approximately.

From this combined perspective, nomic truth approximation, in the sense of increasing truth-content and decreasing falsity-content, can be reconstructed as a matter of revising theories by revising their models (M-side) and/or their postulates (P-side) in the face of increasing evidence. Here 'the nomic truth' is based on as weak metaphysical assumptions as possible.

My pre-2012 work on truth approximation, notably Kuipers (2000), was restricted to maximal theories, that is, theories in which the models are just all structures satisfying the postulates. Hence, the present two-sided approach is a far-reaching generalization. It even leaves room for two extremes: pure theories of postulates and pure theories of models.

To be sure, the recent paper is based on the simplest assumptions about the further nature of theories and their claims. In this paper I want to examine one or two perspectives for concretization, to be chosen from the following list: 1) a quantitative version, 2) a probabilistic version, 3) a *stratified* version based on a (theory-relative) distinction between an observational and a theoretical level, 4) a *refined* version based on an underlying ternary similarity relation between possibilities (notably, structurelikeness between structures).

Kuipers, T., (2000), *From Instrumentalism to Constructive Realism*, Springer, Dordrecht, 2000.

Dynamic logics of belief and evidence.

Pacuit Eric
University of Maryland, UNITED STATES

Rational belief must be grounded in the evidence available to an agent. However, this relation is delicate, and it raises interesting philosophical and technical issues. Modeling evidence requires richer structures than found in standard epistemic semantics where the accessible worlds aggregate all reliable evidence gathered so far. Even recent more finely-grained plausibility models identify too much: belief is indistinguishable from aggregated *best* evidence. At the opposite extreme, one might model evidence syntactically as "formulas received", but this seems overly detailed, and we lose the intuition that evidence can be semantic in nature, zooming in on some actual world.

In this talk, I present a logical framework, developed in a series of papers with Johan van Benthem and David Fernandez-Duque, where evidence is recorded as a family of sets of worlds. Neighborhood models have long been a technical tool for studying weak modal logics. But here, they are used to model a notion of evidence-based belief. I will give an overview of the different logical systems that arise including the main axiomatizations for different classes of models.

Evidence is not a static substance that we have once and for all. It is continually affected by new incoming information, and also by processes of internal re-evaluation. Taking a cue from recent dynamic logics of knowledge update and belief revision, I will present a number of dynamic extensions of evidence models, ranging from update with external new information to internal rearrangement. This leads to a rich repertoire of dynamic logics of "evidence management" and richer languages for neighborhood semantics, including modalities for new kinds of conditional evidence and conditional belief.

Knowledge, Belief, Introspection, Normality.

Roy Olivier
University of Bayreuth, GERMANY

Stalnaker (2006) argued that S4.2 is the correct logic of knowledge. He also shows that KD45 is obtained as logic of belief by stipulating some intuitive relationship between the two types of attitudes. Baltag et al. (2013) and Ozgun (2013) have recently shown that indeed S4.2 embeds KD45, using topological semantics. The talk will start by showing a proof-theoretic counterpart of this result. We then observe that if ones gives up positive introspection for knowledge, the corresponding logic of belief become non-normal. We go on to investigate the properties of this non-normal belief operator. We are particularly interested in understanding how much weaker it is than KD45.

D. FINAL PROGRAMME:

- 09:00-09:30 lecture by Eric Pacuit
- 09:30-09:40 Commentator 1 : Theo A. F. Kuipers
- 09:40-09:50 Commentator 2 : Chenwei Shi
- 09:50-09:55 Discussion
- 09:55-10:25 lecture by Branden Fitelson
- 10:25-10:35 Commentator 1 : Kevin T. Kelly
- 10:35-10:45 Commentator 2 : Zoe Christoff
- 10:45-10:50 Discussion
- BREAK
- 14:30-15:00 lecture by Theo A. F. Kuipers
- 15:00-15:10 Commentator 1: Olivier Roy
- 15:10-15:20 Commentator 2: Sonja Smets
- 15:20-15:25 Discussion
- 15:25-15:55 lecture by Kevin T. Kelly
- 15:55-16:05 Commentator 1: Alexandru Baltag
- 16:05-16:15 Commentator 2: Soroush R. Rad
- 16:15-16:20 Discussion
- 16:20-16:40 BREAK

- 16:40-17:10 lecture by Alexandru Baltag
- 17:10-17:20 Commentator 1: Branden Fitelson
- 17:20-17:30 Commentator 2: Paolo Galeazzi
- 17:30-17:35 Discussion
- 17:35-18:05 lecture by Olivier Roy
- 18:05-18:15 Commentator 1: Eric Pacuit
- 18:15-18:25 Commentator 2: Sonja Smets
- 18:25-18:30 Discussion
- Closing words : Sonja Smets

PHILOSOPHY OF MATHEMATICAL PRACTICE

Sponsored by the Association for the Philosophy of Mathematical Practice (APMP).

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Description and Aim of the Meeting:

The philosophy of mathematics has experienced a very significant resurgence of activity during the last 20 years, much of it falling under the widely used label "philosophy of mathematical practice". As a reflection of this state of affairs, in 2009 a group of researchers in this field gathered to promote the creation of the *Association for the Philosophy of Mathematical Practice, APMP* [for more information, see: *http://institucional.us.es/apmp/*].

Approaches to the philosophy of mathematics that focus on mathematical practice have been thriving. They include the study of a wide variety of issues concerned with the way mathematics is done, evaluated, and applied, and in addition, or in connection therewith, with historical episodes or traditions, applications, educational problems, cognitive questions, etc. We use the label "philosophy of mathematical practice" as a general term for this gamut of approaches, clearly open to interdisciplinary work. APMP members promote a broad, outward-looking approach to the philosophy of mathematics, which engages, with mathematics in practice, including issues in history of mathematics, the applications of mathematics, cognitive science, etc.

APMP aims to become a common forum that will stimulate research in philosophy of mathematics related to mathematical activity, past and present. It also aims to reach out to the wider community of philosophers of science and stimulate renewed attention to the very significant, and philosophically challenging, interactions between mathematics and science. Therefore it is just natural that an affiliated meeting is being submitted to this Congress on behalf of APMP. We asked the members of APMP to submit a proposal for taking part in this meeting and we made an appropriate selection of submission so as to shape a one-day program. The aim of the meeting is to manifest the presence and activity of APMP within the larger community of philosophers of science sand logicians. In order to reach this aim we have opted for the format of ten presentations that showcase the diversity of philosophical work done under the umbrella of APMP.

Proposed Programme:

9:00 – 9:30 Presentation 1, [20min talk + 10 min discussion]
9:30 – 10:00 Presentation 2, [20min talk + 10 min discussion]
10:00 – 10:30 Presentation 3, [20min talk + 10 min discussion]
10:30 – 11:00 *Coffee Break*
11:00 – 11:30 Presentation 4, [20min talk + 10 min discussion]
11:30 – 12:00 Presentation 5, [20min talk + 10 min discussion]
12:00 – 12:30 Presentation 6, [20min talk + 10 min discussion]
12:30 – 14:00 *Lunch Break*
14:00 – 14:30 Presentation 7, [20min talk + 10 min discussion]
14:30 – 15:00 Presentation 8, [20min talk + 10 min discussion]
15:00 – 15:30 Presentation 9, [20min talk + 10 min discussion]
15:30 – 16:00 *Coffee Break*
16:00 – 16:30 Presentation 10, [20min talk + 10 min discussion]
16:30 – 17:00 Presentation 11, [20min talk + 10 min discussion]
17:00 – 17:30 Presentation 12, [20min talk + 10 min discussion]

Abstracts (in alphabetical order):

1. Formalization as a mathematical and philosophical tool

Baldwin John
University of Illinois, Chicago, UNITED STATES

We will consider the role of formalization (as conceived in contemporary model theory) as a tool in both mathematics and philosophy. By this we mean choosing a vocabulary, a logic with syntax and semantics and set of axioms for a particular area of mathematics to address a specific problem. Our consideration is methodological; we don't seek global foundations. I make two general claims:

Formalization of specific mathematical areas is directly important for studying issues in the philosophy of mathematics (axiomatization, purity, categoricity and completeness);

Formalization is directly valuable as a tool for organizing and doing mathematics.

As an example we consider the roles of first or second order logic in the study of Euclidean geometry. This distinction allows us to analyze purity aspects of Hilbert's proof that the Archimedean axiom is unnecessary for grounding Euclidean geometry, in particular the theory of proportionality, while he required second order axioms to ground modern metric geometry.

We use the modern theory of o-minimality to construct a complete first order theory $T\pi$ extending Euclidean geometry that proves the formula $C = 2\pi r$ for the circumference of a circle. There is a constructive consistency proof for $T\pi$ and it has non-Archimedean models.

2. Mathematical practice and human cognition. A critical assessment of Quinn's "Science of Mathematics"

Buldt Bernd
University of Indiana-Purdue University, Fort Wayne, UNITED STATES

Frank Quinn of Jaffe-Quinn fame (see [1]) worked out the basics of his own account of how mathematical practice should be described and analyzed, partly by historical comparisons with 19th century mathematics, partly by an analysis of contemporary mathematics and its pedagogy ([2]).

Despite his claim that for this task "professional philosophers seem as irrelevant as Aristotle is to modern physics," this philosophy talk will provide a critical summary of his main observations and arguments (unpublished except for [3]). The goal is to inject some of Quinn's remarks to the current conversation on mathematical practice.

[1] Jaffe, Arthur, Quinn, Frank. "Theoretical Mathematics: Towards a synthesis of mathematics and theoretical physics," Bulletin of the American Mathematical Society NS 29:1 (1993),

1–13. [2] Quinn, Frank. Contributions to a science of mathematics, manuscript (October 2011), 98pp.[3] Quinn, Frank. "A revolution in mathematics? What really happened a century ago and why it matters today," Notices American Mathematical Society 59:1 (2012) 31–37.

3. Frege on acquaintance

Costreie Sorin
Romanian Academy, Iasi Branch, ROMANIA

My paper is a discussion of *acquaintance* in the framework of Frege's philosophy, and is also a reaction to two recent papers of Saul Kripke and Palle Yourgrau. Both endorse a very Russellian interpretation of Frege's theory of sense, based on the fact that somehow Frege needs to make room in his system to a kind of *sense-acquaintance* notion. Both argue that Frege needs this in order to account for our ability to refer in indirect discourse to sense. There is no other way out for them.

I shall argue against this interpretation of Frege's philosophy of sense and reference. My argument is based on a twofold reason. On one hand, Russell's acquaintance pertains only to sense-data, our self-consciousness, and concepts. Certainly, Fregean senses could not be considered either sense-data, nor self-consciousness, for it would make them subjective and very akin to ideas, i.e representations in our mind. So, if we pursue this line of thought, it remains only to consider them as being concepts. Yet, on the other hand, knowledge-by- acquaintance is for Russell knowledge of things. Russell's notion of 'thing' stands for Frege's notion of 'object'. So, at the end of the day, that would make Frege' senses objects. But could we argue coherently that Fregean senses are both concepts and objects? I do not think so, for nothing for Frege could be both concept and object; in this way, we shall break Frege's most fundamental principle that everything is either a concept or an object.

References: Kripke, S. (2008) – "Frege's Theory of Sense and Reference: Some Exegetical Notes", *Theoria*, 74, pp. 181-218 Yourgrau, P. (2012) – "Kripke's Frege", *Thought*, 1, pp. 101-7

4. Impossibility theorems and the elimination of modality

Crippa Davide
Université Paris Diderot, FRANCE

The questions whether modal notions have a role to play in our understanding of the nature of mathematical objects and mathematical knowledge, and whether an appeal to modal notions is legitimate at all in the mathematical discourse has become a urgent issue within several philosophical accounts.

In this talk, I purport to explore this question from the viewpoint represented by the study of mathematical practice(s). In other words, I am looking for a plausible rational reconstruction of the practising mathematician's modal talk by considering case studies in which modal expressions are used in a non-conversational way (i.e. within definitions, problems, theorems and lemmas). In particular, this talk will focus on occurrences of impossibility claims in mathematical contexts within ancient and early modern geometry.

As a start, I shall pose the following, preliminary question: is there a general strategy underlying the proof of the above impossibility statements, in their respective mathematical theories or contexts?

I shall advance here a provisional answer in the light of certain well-known cases. Since classical mathematics does not possess adequate resources in order to treat modal operators, a proof of an impossibility statement is usually obtained by eliminating its modal content through a suitable paraphrase into an equivalent, non-modal statement. Subsequently, the non-modal counterpart is proved by relying on (non-modal) logical inferences. This hypothesis suggests a further distinction between reducible and irreducible impossibility statements, depending on the conceptual and mathematical resources employed within a given fragment of mathematics.

On this ground, I shall start to depict a possible conceptual and historical shift, focussing on how the logical status of modal statements concerning the constructibility or non constructibility of elementary geometric problems (in particular the trisection of the angle, the duplication of the cube and the quadrature of the circle) did change from ancient to early modern mathematics.

5. Pluralist mathematical practice

Friend Michele
George Washington University, UNITED STATES

"The Hungarian Project" is the honorary name given to a programme to give the logical foundations of theories of physics. The methodology is pluralist. The Hungarians carrying out the programme claim to have a better understanding of the physical theories than they would have done had they studied the theories in the standard way: from the laws of physics as they are given to us in physics classrooms and textbooks.

In this presentation I explain the programme, outline the methodology, point out in what sense it is pluralist, and in what ways it could become more pluralist. I also discuss the epistemological advantages and disadvantages of the methodology.

The programme started with exploring 'the logical foundations' of special relativity. Here, 'the logical foundations' means a set of axioms written in a first-order language with some constants to refer to physical entities such as inertial bodies or photons. The Hungarians then developed the logical foundations of general relativity, and could show the formal logical relationship to special relativity. They are currently working on Newtonian Mechanics and have ambitions to eventually develop the logical foundations of quantum theory.

The methodology starts with the observed data of the physical theory. This stays fixed, since it is this that the Hungarians want to understand. They then develop a logical language that can be used to describe the data, work 'backwards' to find out what axioms could be used to derive the data as theorems. They also derive some of the textbook 'laws of physics' as theorems. Of course, the direction is back-and-forth. The goal is to find the logically simplest and more logically intuitive axioms. But they do not stop once they have found some logical axioms powerful enough to derive all the data. The axioms are not new laws of physics!

Instead, they then explore what happens if they change the axioms, by simplifying them or weakening them. So, they end up with a number of axiomatic systems each of which derives all or some of the data as theorems of the formal system. So we have a plurality of formal axiomatic systems that *together* give the explanation of the physical data, or so the Hungarians claim.

The methodology is pluralist in: formal axiomatic systems, in ontology and in truth. Each of these terms will be explained, and more respects in which they methodology is pluralist will be added. Suggestions will also be made as to how they could be even more pluralist without loosing sight of the greater goal of understanding the physical theories.

The methodology is not for everyone. It requires logical sophistication, and is best suited to those who understand through logic, not through intuitions of physical reality. As a method for understanding science, the advantages come from asking logician's questions about the theory and data. They include an understanding of the logical limitations of the theory and the ability to make predictions in the form of, for example, showing that some phenomena such as superluminal (faster-than-light) particles, is *logically consistent with* the theories of relativity.

6. The research mathematician's working tools, cognitive strategies and the training of the mind

Goethe Norma
National University of Cordoba, ARGENTINA

It is often assumed that formal text book presentations in mathematics reveal the structural organization of mathematical concepts but, as it has been argued recently from different perspectives, what is characterized formally in such presentations not only leaves out a great amount of inferential organization of the notions underlying reasoning in mathematical practice, it also fails to capture a variety of cognitive preferences that point to the ways in which the research mathematician designs his working tools and explorations. From the perspective of cognitive science, for instance, there are important conceptual metaphors that come into play when modeling mathematical expressions, which help conceiving mathematical notions, but none of such metaphorical uses can be reduced to literal expressions without losing the cognitive insight the metaphor was conveying. In my talk I will draw on some case-studies to discuss the relevant interaction between working tools, cognitive strategies of the researcher and the study of such practices.

7. Why 'scaffolding' is the wrong metaphor

Larvor Brendan
University of Hertfordshire, UNITED KINGDOM

The metaphor of scaffolding has become current in discussions of the cognitive help we get from artefacts, environmental affordances and each other. Consideration of mathematical tools and representations indicates that in these cases at least (and plausibly for many others), scaffolding is the wrong picture, because scaffolding in good order is immobile. It is a vital feature of mathematical representations that they can be manipulated. This is of interest to philosophers of mathematical practice because almost all mathematical activity involves some sort of representation external to the brain.

8. Motivating proofs

Morris Rebecca
Carnegie Mellon University, UNITED STATES

A proof is supposed to do more than just establish that a certain mathematical result holds. Although we may recognize the correctness of an obscure or perplexing proof, we will still find it unsatisfactory and poorly motivated. George Polya gave an analysis of motivation and suggested that, for a proof to be motivated, the reader must be able to recognize that the important steps are appropriate. In this talk I will present an account of motivation that builds on Polya's work. In particular, by making use of historical case studies from number theory, I'll further analyze what it means for a reader to recognize that a step is appropriate and identify ways to transform a poorly motivated proof into a better motivated one. More specifically, I'll identify two senses in which a step can be recognized as appropriate: (i) the reader can easily identify the manner in which the step advances the argument and (ii) the reader can easily identify how the step fits in with previous ones. I suggest that, in a motivated proof, the reader will recognize each step is appropriate in both of these senses. I'll then discuss how the mathematical context against which a proof is considered, as well as the organizational structure of the proof, and the mathematical language used, can impact its motivational efficacy.

9. Innate Abilities & Algebraic Reasoning

Muntersbjorn Madeline
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Otto Neurath (1882-1945) advocated for social change by means of public education. He developed a symbolic language, Isotype, to communicate complex statistical data to people without formal education. This method was based on his recognition that reading, in general, and reading numerical expressions, in particular, is an acquired skill that does not come naturally but requires extensive training. In contrast, people recognize differences in relative magnitudes "at a glance." That is, most people are born with the ability to see which tree is taller but have to be taught that 123, 456, 789 is less than 123, 465, 789. Computing this difference may be simple arithmetic but performing this operation requires complex skills that must be cultivated. Further, mathematical literacy involves more than manipulating numerals. Learning to use algebraic symbols to express mathematical relations is notoriously difficult, especially since people commonly conflate mathematics with arithmetic and, as a result, have difficulty parsing strings of non-numerical symbols. The equation, A v (B & C) :: (A v B) & (A v C), expresses an important equivalence relation while A v (B & C) :: (A & B) v (A & C) does not; but neither expression looks like mathematics to the uninitiated. As a result, people struggle to make connections between story problems and symbolic reasoning. Many identify with fictional characters who assert, "I have no use for algebra" because "In real life there is no algebra." In contrast, philosophers of mathematics may be more inclined to be realists about abstract relations than actual numbers: some trees are taller than others even as the means used to measure these differences are arbitrary artifacts of our own creation. This talk explores the gap between expert and novice perspectives on algebra and considers whether there are innate abilities educators can exploit to make algebraic relations easier to see, both in the classroom and in the "real" world. In other words, if Isotype is to statistics as X is to algebra, can we solve for X?

10. From proto-arithmetical to arithmetical

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In modern philosophy of mathematics it is increasingly widely accepted that arithmetical thinking is built on a primitive ability to deal with quantities. These biological primitives, which are already present in infants and many nonhuman animals, are thought to give us the basic notion of a discrete quantity. While the primitive ability has been extensively studied empirically, much less is known about the move from the proto-arithmetical processing of quantities to developed arithmetical thinking. A common hypothesis (e.g., Spelke) states that it is with the development of sufficient linguistic ability that we manage to move beyond the primitive ability. In this talk I will study the philosophical aspects of that hypothesis. The talk consists of studying two key questions. First we need to determine at which point we can say that we have moved from proto-arithmetic to arithmetical thinking proper. After this has been established, we can study the necessary and sufficient conditions for the development of arithmetical thinking. I propose that the important transition from proto-arithmetical to arithmetical comes when we understand that all natural numbers are fundamentally alike and part of an endless progression. At that point, we know the essential structure of natural numbers and can generalize on operations on them, even if we may lack the formal tools to present the system explicitly. However, it seems that we require enough expressive power from our language to be able to state the general idea of a successor function. In addition, we must have a way of treating endless processes as objects. Arithmetic thus conceived can then be developed further, ultimately to formal axiomatic systems. But in the development of arithmetical knowledge, I will argue, the crucial steps have been made earlier. When we want to study the nature of arithmetical knowledge, this is important to remember.

11. Philosophy of arithmetic and number cognition: re-assessing the basis of interdisciplinarity

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The objective of this talk is to examine the research on the concept of natural numbers in philosophy of mathematics and in research from developmental cognitive science. Firstly, I reconsider Frege's severe criticism of 'psychological influence' in foundations of mathematics (presented in *Grundlagen*). The question I ask is if his arguments can still be applied to the contemporary research in the two disciplines.

Secondly, I compare the conceptual frameworks of the two disciplines. In this comparison I will highlight similarities and differences. Furthermore, I provide contemporary examples of how the application of results from one discipline to the other may fail. I use these examples to consider how interdisciplinarity on the subject of natural numbers can be made fruitful. I suggest that methodological constraints may be prudent to this.

Finally, I propose a promising way to study the collaboration between philosophy of mathematics and developmental cognitive science. The proposal is similar to the principle for formulating foundations of mathematics called Frege's Constraint. According to this principle, any adequate foundation of a mathematical theory must explicitly account, even at the most fundamental level, for the applications of the entities it is intended model. I suggest to apply this principle to the case of natural numbers and investigate how results from developmental cognitive science may support various versions of it.

12. Dedekind, Frege, and the foundational quest

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In the late nineteenth century, both Richard Dedekind and Gottlob Frege proposed new "foundations" for arithmetic. Both maintained, moreover, that this could be done by using tools from "logic". And there were further similarities between their approaches, e.g., the use of general theories of functions and classes as part of their "logicism". In this talk, I will probe the question of what was motivating this shared foundational quest, including whether there were any interesting differences between the two in this respect. I will argue that for both not only mathematical but also philosophical issues were at play. In addition, there was no sharp line separating these two kinds of issues, as the case of Dedekind makes especially clear. In that respect, I will try to make evident how philosophical issues can grow out of mathematical practice, as opposed to being imposed on it from outside. The discussion will also lead us to several more specific questions, including: a) What were the main mathematical and philosophical influences on Dedekind and Frege, i.e., what is the relevant historical background here? b) What was the basic goal, or what were the goals, in providing a new foundation for them; or put differently, what is meant by "foundation" in this context? c) How did Dedekind and Frege, respectively, conceive of "logic", such that general theories of functions and classes could be seen as included in it? Finally, d) how do some of their most celebrated mathematical achievements fit in, such as Dedekind's categoricity result concerning the notion of a "simple infinity" (a version of the Dedekind-Peano axioms), their parallel treatments of mathematical induction, and Frege's formulation of a version of higher-order logic, including formal deduction principles for it?

A pragmatic logic for denial (LPD)

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Assertion ($\vdash$) and denial ($\dashv$) are mutually incompatible speech acts. A logic for illocutionary act of assertion–the *logic for pragmatics* (LP)–has been proposed by Dalla Pozza and Garola (1995). The basic idea of LP is to follow Frege's idea of distinguishing propositions from judgments: A proposition is either true or false, while a judgment, expressed through the speech act of an assertion, is either justified (J) or unjustified (U). A justified assertion is defined in terms of the existence of a proof that the asserted content is true. Elementary sentences of LP are built up using only the sign of pragmatic mood of assertion.

In the paper we consider an extension of LP, (LPD), based on the notions of *what is rational to accept* and *what is rational to reject*. Briefly put: It seems adequate to argue that if $v(\vdash A) = \mathsf{J}$ then it is rational to accept A and, on the same line, if $v(\dashv A) = \mathsf{J}$ it is rational to reject A. Moreover, if $v(\vdash A) = \mathsf{J}$ then it is rational to reject $\neg A$. We analyse this characterization of denial in LPD. The new proposal seems to capture a basic requirement for the extension of LP: if to assert a certain proposition you need a proof of it in LP, to reject it you need something like a 'disproof' of the same proposition. Such extension, its *pro and cons* will be analysed.

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Philosophical Problems of Information and Network Societies

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"Progress of Cognition in Network Society".The report provides a philosophical analysis of network society from the position of constructivism theory. It is proved that the conception of a person as a constructor of the real world can be considered like basis of this type of the society. It's advanced the idea that the network society should be explored as a qualitatively new sphere of a man's creative and constructive activity. According to the conception of network society, the author makes a conclusion that the process of cognition in it has a universal character. While communicating, representatives of different branches of knowledge draw up norms and standards accepted by the whole scientific society involved in the process. Emerging "virtual reality" is pointed out as the main disadvantage. The reason is that even today, when we live in network society to a large degree, it's possible to state that social networks and virtual reality brought with new modern technologies lead to man's egocentrism, because he begins concentrating on his personality and thoughts more and more losing the connection with real world. Eventually, we can see that nowadays gender relations also acquire virtual character more and more as it becomes enough to switch on your computer, surf the Internet and find any sexual partner you like. Man can introduce himself as a monster or a super guy and it doesn't matter what he is in the reality. That's why spatial ideas of physical borders of communication and identification are being changed. The reason is man's presence in the communication environment being cognized as virtual and real simultaneously, but it's an absolutely new phenomenon of human existence.

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Transfinite graded Turing progressions and modal logic.

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Turing progressions are hierarchies of theories such that given an initial base theory T, we build transfinite sequences of extensions of T by iteratedly adding different n-consistency statements. It is known how Turing progressions are related to the Gödel-Löb Polymodal logic **GLP** and its positive fragment **RC**, introduced by Beklemishev and Dashkov. However, at limit stages, these systems cannot directly denote Turing progressions but just approximate them. In order to get a logic which can be used to directly denote limit progressions, the authors have introduced the system **TC** based on a new modal strictly positive language which includes a set of *ordinal modalities*, i.e. pairs $\langle n, \alpha \rangle$ where $n < \omega$ and α is an ordinal below ε_0. This system has been proven to be sound and a first investigation is being undertaken into the relations between **RC** and **TC** and Kripke semantics.

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