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Editorial

It is a great pleasure and honour to return as a guest editor of *The Reasoner*. For this issue I have asked Alexis Tsoukiàs to sit down with me for an interview. He is Director of LAMSADE (Laboratoire d'Analyse et Modélisation de Systèmes pour l'Aide à la DÉcision) at the University Paris-Dauphine, CNRS Research Director and former

President of EURO, the European Association of Operational Research. As Alexis said during our conversation, his interest in operational research and multi-criteria decision support began during his studies in civil engineering and (which may seem rather surprising at first) was linked to his political activity.

In the pages of *The Reasoner*, we have often read articles on decision theory, but not on operational research. Yet, decision theory and operational research may be viewed as the same discipline. Operational research is deeply motivated by practical problems, but its tools are formal tools that come from the interaction with disciplines like mathematics, logic, computer science, philosophy and psychology. When an expert helps a client to make a decision, the use of a formal and abstract approach eases the definition and analysis of the problem and allows a justification of the solution. This entails the assumption of a model of rationality that is, however, neither fixed nor given. In fact, the decision-aiding process involves several individuals participating in the construction of such a notion of rationality, which will finally legitimate the decisions. These topics have often been discussed in *The Reasoner* and I think that decision-aiding may provide a different angle to reflect on these issues. This made Alexis an excellent interviewee for *The Reasoner*. So, I now leave the floor to him; Alexis will explain to us what decision-aiding has to do with policy-making, psychotherapy and tap water!

GABRIELLA PIGOZZI
LAMSADE, Université Paris-Dauphine

FEATURES

Interview with Alexis Tsoukiàs

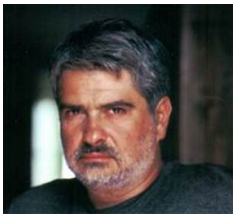
Gabriella Pigozzi: How were you initially drawn to decision-aiding?

Alexis Tsoukiàs: It was a matter of chance. When I was a student, I almost abandoned engineering studies because there was very little mathematics in classes. So I was strongly tempted to move to pure mathematics. And then it happened that I started following classes on operational research and I was attracted to the subject. One reason was that it has strong mathematics content, the other that it was applicable and it was related to ideas I had about policy-making. At that time I had very strong political activities and the relation between mathematics and supporting political activities was very intriguing for me. So that was perhaps one of the main reasons that explain why I was drawn to this subject. Classes were interesting, I did my Masters thesis on that and a couple of years later I had the opportunity to do a PhD on the same subject. And that's how the whole story began.

GP: Can you say a bit more about the relationship between politics and mathematics?

AT: I was attracted by the idea that some of the processes of

policy-making I had been involved in could be modeled and supported by some formal tools. For somebody who loved mathematics, that was intriguing. So that is how I was drawn to this area. Of course later I have realized that these concepts and tools can be used for many different things and not only for policy-making. But my first applications were in policy-making and my Masters thesis was on policy-making and decision-support.



GP: In your career you have practiced decision-aiding both for private and public organisations. I would like to know how decision-aiding differs when you work for (and with) the private and the public sector and with private and public actors... if there are any differences.

AT: On a very practical level I do not think that people see any difference. It is more at the level of deep reasons that you could see these differences. Basically, you realise that when you try to help someone to make a decision, practically what you do is to help him (or her) to construct the legitimation to decide. Now, in the private area, there is a strong legitimation to decide that comes from ownership. It may be because you have the majority of the stakes, or you are the owner of the company, or the owner delegates you. Now, in most of the public decision situations, this legitimation is far less clear. It is far less clear what is the source of this legitimation. Even in those cases where apparently the law, for instance, or some regulations set the source of such legitimation clearly. Practically, most public policy decision-making is participative *de facto*, which makes the source of legitimation more distributed. And this is why there are some differences between decision-aiding in the private and in the public sector.

Now, for several other aspects there are no big differences: decision-makers rarely know what they want, are rarely very clear as to what they are talking about, almost never declare immediately what the problem is exactly (perhaps they even do not know what it is), and the time is not regular, the density of the time varies in different moments of the process. These are things that you observe in all cases. So as you see, the differences between private and public decision-making or private and public decision-aiding are rather deep rooted, not apparent in the decision process.

GP: You said that often people who have to take a decision do not know what the problem is. This reminded me of that article in which you provocatively compare the person who helps to make a decision with a psychotherapist. Often, in fact, people who seek the help of a psychotherapist cannot clearly define their problem.

AT: OK, yes. It was written to provoke discussion. However, there are some aspects that are intriguing. Let us start from the similarities. The similarities are that you have clients (or patients), these clients have problems, and you are expected to give some advice. I would say that the similarities end here. A big difference is that in formal decision-support (which is what we traditionally practice), what you are trying to do is to construct a legitimation, which is publicly observable, which can be spent, which can be used outside. You also need to convince your client that what you do makes sense and, in order to convince him, he needs to see that he can use it outside. This is not the case in psychotherapy. In psychotherapy you need to convince your patient that you face the situation which he is in. But that is something that he is going to use with himself.

The other difference is the language. We use formal languages: we use mathematics, logic, ..., whereas psychotherapy uses verbal communication. In some sense, the ambiguity of verbal communication is part of the therapy itself. Finally, there is another difference... psychotherapists do not have the alibi of rationality. So from that point of view, they are keen to be controlled in what they do in their practice. Any psychotherapist who respects his job will regularly submit his therapies to supervision. There are clear rules about when a patient can ask a third party to assess whether a therapy has been done correctly or not. This is not our case. I think that the reason is that, with the alibi that we provide rational advice, nobody needs to check it. If it is rational, it is correct. Now, this is false. The rationality we provide is not a standard rationality. It is something we construct. Thus it can be discussed, it can be accused and it can be modified. Unlike other people whose profession is to help, people in our area accept this point far less. They think that what they do is right and unfortunately it is not always the case.

GP: You work in a computer science department and you are Director of LAMSADE. What do you think the role of decision aiding is in relation to other topics or disciplines in computer science?

AT: For me computer science is just part of decision sciences and technologies. But once again, this is a provocation. What I claim is that our lab, more than being a computer science lab, is a lab in decision sciences and technologies. I think that there are some mutual benefits and interactions between what we call mainstream decision theory and what we call mainstream computer science. Decision theory can be greatly improved by considering the very serious problems that algorithms and data provide in supporting a decision process. Supporting a decision process is not an abstract activity. It is something that you do with algorithms, with data, with procedures and protocols. And this is something that computer scientists have studied since the beginning.

Now, the other side of the coin is that most computer science problems are decision problems. So if we enable computer science to make use of the smart results that decision theory has produced, then we greatly improve what we can do with algorithms, protocols, and procedures. This is why I see a very deep and profound interaction between these areas and this is why with colleagues in DIMACS, at Rutgers University, we invented the area of algorithmic decision theory. But parallel to that, consider that 'new' areas like algorithmic game theory, computational social choice, and algorithmic learning are at the edge between the computer science mainstream and the decision theory mainstream.

What I see in the foreseeable future is a greater integration between these two areas. I am sure that most foundational problems in computer science will be solved through decision theoretic contributions. Think, for instance, how game theory and general equilibrium theory helped Papadimitriou reconstruct the classes of complexities. And similarly, many foundational problems in decision theory will be greatly improved through contributions of computer science. I really think that by the time I retire there will be brilliant results in these domains.

GP: What are you working on now? I hear a lot of talk about policy analytics. What is this policy analytics all about?

AT: What I really do at the moment is managing the lab, which adsorbs something

like 120% of my time. Then I have a family... So, in the limited spare time I try to develop some new research directions. One has been algorithmic decision theory. What I would like to develop now is policy analytics.

Now, what is that? Let us be sincere. In part it is a buzz for fund-raising. Analytics today is a keyword for many areas, both in decision theory and in computer science. So we want to get connected to that. That said, I am convinced that what people usually consider analytics (which, to be clear, is business analytics, Google analytics, etc.) does not fit what people in policy-making mean. So we need new tools, but especially new methodologies, which means facing some issues that usual analytics would not consider. One is to consider what the problem is. In many analytics contexts the problem is taken to be given. This is false. In policy-making a problem needs to be understood, shared, constructed. The second big difference is that most analytics is data-driven, while policy-making is value-driven. So we need to learn values. It is not only learning about data. I do not say we do not need data. On the contrary, we need evidence, strong evidence. This is necessary but not sufficient. We need to learn more about values. This is crucial. I can tell you a small story.

We have some raw statistics of some underdeveloped countries for which 95% of rural households do not have access to tap water. Somebody could be induced to say: "OK, this is a national priority. We need to connect rural households to water" since water is a basic need. Now, making an inquiry among householders on whether this is really a priority, you will see what may appear as a strange reaction, of the sort of "No, not really. Health is a big priority". This looks strange because water is such a basic need. After a bit of thinking, there may be an explanation. Householders are men, while fetching water is a women's activity. So we thought, perhaps if we ask women, we get a different appreciation. So we did a discrete inquiry among women on whether getting access to tap water would be a priority. No. For women the priority was education, especially allowing young girls to get educated. Water was really not a problem. At first this was really strange. But then, if you dig deeper, you realize that for these women fetching water is the only social activity they have independently from their men. They are allowed to get out of their houses only when they need to fetch water. So if we put tap water in their houses, these will become a prison. Now, if we do not learn values, we could condemn these ladies to a prison with all the good will. These are the typical things we need to think when we think about policies, and this is something that usual analytics will not allow us to emphasize, to put in evidence. So policy analytics is how to make a step further with respect to what usual analytics is doing by facing new types of challenges.

We have just published a paper about policy analytics in the inaugural issue of the *EURO Journal on Decision Processes*, so people may have a look at that to see more details.

GP: Finally, I would like to know what you consider to be the most important open problems in decision aiding. You mentioned already some of them. Do you see other problems that you judge important in decision aiding, and what do you think the prospects for progress are?

AT: There are many open problems. I will mention three of them. There is a big problem that, in my opinion, will last for a long time. And this is the reconstruction of

the whole axiomatic theory of decision theory on the grounds of conjoint measurement theory. This is a huge challenge. And since there are not many people working on that, I expect this to last for several generations before we can really say that we have been able to solve it. But this is the only real effort I have seen trying to unify the axioms behind social choice, game theory, decision theory, optimisation, decision under risk uncertainty. It is really a huge challenge and I really admire people working on that because it is a very long-perspective issue. So the long-term challenge here is how to construct a decision aiding methodology. Decision aiding is not just a sum of methods. We need some reasoning on how these methods, procedures, protocols etc., are used. A big part of that is axiomatic, and we are far from having axioms that unify these aspects. So, generally speaking I think that a big challenge is to unify decision theories in a decision aiding methodology.

The second big challenge is how to construct reasons for a decision maker. This is a very practical challenge although it has a theoretical flavour. On a very practical level, what clients ask us for are not models, it is advice. So we can compute, we can perform complex optimisation etc. But we have to give the client not the computing or the optimisation model. We need to tell them what we advise them to do, and we need to explain to them *why* we advise them to do so. So we need to give them the reasons for a certain decision. And this needs to be convincing. If we want to do that seriously and if we want to do it in a robust way, we need some theory of that. And here is where I think argumentation theory comes into play. For the time being, argumentation is the only theory I have found that allows us to check and test whether what we tell our clients is robust. How strong will our advice be when our client will go into a committee or a meeting with his director? Argumentation theory gives us the tools to check that. It may appear contradictory because this is a theoretical challenge for a very practical problem. Nevertheless I think that this is a very big issue.

Finally, the third problem is about preference-learning. I am definitely convinced that our learning methodology should make a step forward learning values and models. Not only to elicit parameters or rules; we need to learn more complex things. And the research done in the area of preference-learning is what I see as the most promising approach to the idea of complex learning. How much time will all this take? I do not know. I am sure that when I retire all these will still be open problems!

GP: Well, thank you very much for this interview!

Wouldn't Socrates have to be present?

Let us consider the following scenario. After I take attendance in my logic class, I claim 'Everybody is present'. I then apply the rule of Universal Instantiation (UI) to 'Everybody is present' and since 'Socrates' is a name in my language, I infer that Socrates is present. If the rule were sound and the premise true, then Socrates would have to be present, but he is not. Accordingly, the premise is false or the rule is unsound. Most logicians would opt for the first option, but Christopher Gauker is not your typical logician. Thus, in Words Without Meaning (2003: MIT), he first argues that, if the premise were false, "we would hardly ever utter universally quantified sentences that were strictly speaking true, which is not very plausible" (page 154); and then he opts for the second

option. For him, the argument is a genuine counterexample to UI.

Accordingly, in his book, Gauker rejects UI and argues for a novel understanding of logical validity as preservation of assertibility in a context. According to him, "we can give a better account of the logical relations between sentences if we think of logical validity as preservation of assertibility in a context rather than as a relation between propositions" (page 145). So, on his account, 'Everybody is present' can be assertible in C, while 'Socrates is present' is neither assertible nor deniable in the same context C.

In spite of their merits, I will neither explore Gauker's understanding of logical validity nor his overall conception of linguistic communication. Instead, I will consider two potential defenses of UI.

(i) Grammatical vs. logical form: The premise is true, but there exists a mismatch between its grammatical and logical form. In our case, the true logical form of 'Everybody is present' is 'All the students enrolled in my class are present' ('For all x, if x is a student enrolled in my class, then x is present') and if the premise is a conditional proposition, then the conclusion does not follow. But for Gauker, this "observation is not a way of defending universal instantiation; it is just a way of explaining the counterexample" (page 150).

(ii) Domain of discourse: UI presupposes the existence of a contextually given domain of discourse. Accordingly, although the rule is sound, the inference is fallacious because in that context the name 'Socrates' does not refer to anyone in the relevant domain. As a result, we can retain the grammatical form of the premise without licensing the inference in question. But according to Gauker, this is not what the rule says. The rule does not mention any contextual constraint. It says that we can always replace the variables in question with any name in our language (see pages 152–153).

Some manuals, like Barwise/Etchemendy (1999: Language, Proof and Logic, University of Chicago Press), add to "From $\forall x S(x)$, infer $S(c)$" the following clause: "so long as c denotes an object in the domain of discourse" (page 321). But, as Gauker himself pointed out to me, since UI should be a purely syntactic rule and 'denotation' is a semantic notion, Barwise/Etchemendy's formulation is not satisfactory. In any case, in this feature, I will solely focus on (i).

Surprisingly, Gauker seems to believe that (i) counts in his favor. But this is a mistake. It's true that both Gauker and (i) reject the validity of 'Everybody is present; therefore, Socrates is present', but their reasons are different. For Gauker, the argument fails because UI is unsound; for (i), the argument fails because it is an instance of an invalid inference form: '$\forall x(P(x) \Rightarrow Q(x))$; therefore $Q(a)$', rather than an instance of UI.

In any case, we are now confronted with a clear dilemma: should we take the argument in question as a genuine counterexample to UI and thus, reject the rule? Or should we preserve UI and, accordingly, interpret the premise as a conditional proposition? There can be reasons for both options. In one case, we give up an intuitive rule but we preserve the grammatical form of our premise. In the other, we preserve the rule but we introduce new entities, namely, propositions.

Philosophers face a similar choice when thinking about Russell's Theory of Definite Descriptions. Russell's theory distinguishes logical and grammatical form in order to rescue the rule of Existential Generalization (EG) from similar counterexamples.

Consider the following argument: 'Sherlock Holmes is a detective; therefore, Sherlock Holmes exists'. The premise is true, but the conclusion is false. So, EG must be invalid. However, if following Russell, we replace 'Sherlock Holmes' with a definite description ('Moriarty's greatest enemy', for example) and we interpret the premise as '$\exists x(MGE(x)\&\forall y(MGE(y) \Rightarrow y = x)\&D(x))$', it turns out to be false and the counterexample vanishes.

That EG is subject to similar counterexamples should not be surprising. After all, since the quantifiers are interdefinable, UI and EG are mutually dependent. Gauker is much aware of their dependency (see pages 151–152). However, his conception of logical validity discards UI and preserves EG. EG "is not subject to the same doubts", he claims on pages 151. And on page 153, he writes: "But in fact there are no such apparent counterexamples to existential generalization". Nevertheless, as we just uncovered, this is false. (To be fair, I think that Gauker means to say that there are no genuine counterexamples to EG: in a context in which 'Sherlock Holmes is a detective' is assertible, we should also be able to assert that Sherlock Holmes exists).

In any case, faced with 'Everybody is present; therefore, Socrates is present' we do not have to come to the conclusion that UI is unsound for there exists some less radical options. So, in spite of what Gauker believes, his rejection of UI cannot be motivated by his counterexample, but only by a prior theoretical commitment.

Giovanni Mion
Istanbul Technical University

Questions for Mion on Evidence and Proof

The New Atheist's "*No evidence needed thesis*" is the claim that they do not need evidence for their position. The unprovability of negative existential empirical claims and the Hanson-Scriven thesis (HST), "absence of evidence is evidence of absence", would constitute two justifications for such thesis.

Giovanni Mion (2013: Where the evidence is not needed, *The Reasoner* 7(11)), defends those two justifications from attacks by Michael Antony (2010: Where's the evidence?, *Philosophy Now* 78). According to Antony, negative existential claims can be proven, as in mathematics, logic or other conceptual inquiries. Following Popper, Mion replies that although mathematical, logical or conceptual negative existential claims can be proven, demanding a proof of an unrestricted negative existential like "God does not exist" is mistaken because it is not provable in the empirical relevant sense as it requires an impossible search across the whole universe.

On HST, Antony says that it has restricted applicability, since there are claims for which there is little or no evidence but are not thought thereby to be false, for example

> STRINGS: *String theory is correct.*

When discussing STRINGS, Mion shifts without warning to

> STRINGS-Mion: *There is a theory that unifies general relativity (GR) with quantum mechanics (QM).*

In the context of existential claims, a more natural interpretation of STRINGS is "There are strings". However, I will follow him granting that STRINGS implies STRINGS-Mion. Mion says that, unlike some of Antony's other counterexamples, it seems to have the correct logical form, an affirmative existential claim, and that it seems empirically verifiable, "by looking into an encyclopedia, for example". Nonetheless, Mion says that "in the relevant sense, the claim in question is not empirical", so HST could not be applied to it, because also mathematical truths would be empirically verifiable in that way.

In this note I want to express some doubts about Mion's strategies to defend the justifications of the *No evidence needed thesis*. A non-negligible part of Mion's argument rests on the "relevant senses" of 'empirical' and 'empirically provable' without clarifying what those relevant senses are, but even under such ambiguity his arguments are not so straightforward.

Consider the case of aether. According to Mion, "to prove its non-existence is outright impossible". It can be outright impossible in Newtonian physics (NP); since the existence of aether is a postulate of the theory, it is no wonder that repeated failure to verify it does not constitute a proof of its non-existence. But its non-existence can be proven since the aether postulate contradicts most of contemporary mechanics (CM): If CM holds—and we have good reasons to think it does—there is no aether, and even experiments carried out under the hypothesis of the correctness of NP give empirical support to that conclusion. If it is replied that "There is no aether" is not a non-existence claim because it is not a non-existence claim *simpliciter* but one given some background, then there are no existence claims in mathematics, logic or anywhere, either. So, it is not clear that proving negative existential empirical claims "is outright impossible".

Regarding the applicability of HST to STRINGS-Mion, he missed the mark. An encyclopedia saying that there is a certain theory does not verify the existential claim concerning that certain theory. The encyclopedia provides at most evidence that the theory has been proposed and that at some point it has been taken with certain degree of seriousness. But STRINGS-Mion is true iff there is a theory that in fact unifies GR with QM, that is, roughly, iff there is a single theory UT that contains both the right claims of GR and QM but none of their wrong claims (say, the wrong predictions that they made about the domain of each other before the unification). GR plus QM and none of their wrong claims would be consequences of UT, and this amounts to say that UT unifies GR with QM, so UT has as consequence that there is such a unifier theory. Then the claim would be an empirical one, as it is a consequence of an empirical theory. That there is such theory is therefore verified by testing the candidate theories, not by reading encyclopedias. Thus, STRINGS-Mion falls under the scope of HST, like STRINGS and its most natural reading "There are strings".

A better move against someone who says that endorsing STRINGS-Mion is a counterexample to HST because there is no or little evidence for it yet it is widely believed, would be rejecting their claim that there is little or no evidence for such theory. It may be the case that there is little or no evidence that we already are in possession of a UT, but this is evidence against "There is a theory that unifies general relativity with quantum mechanics *and we are already in possession of it*". The evidence for the original claim comes from the history of physics and its successes in unification.

However, Antony explicitly mentioned string theory. He says that "there is nothing that could properly be called strong evidence for it, yet many physicists believe it." If HST is right, then one should conclude that string theory is false. But neither friends nor foes of string theory are acting against either HST or the idea that something must be believed only when in possession of enough evidence. Those many physicists who believe in the correctness of string theory do not believe it in absence of evidence. Rather they think they have enough evidence and that is why they believe in it, notoriously including what they take to be absence of evidence for rival theories. Foes, of course, think that the evidence is not enough, and that is why they do not believe it. Antony would be wrongly demanding that HST produces consensus; that is difficult because there is no consensus about what constitutes enough evidence.

Thanks to Daniel Cohnitz, Giovanni Mion, and the referees for their comments. This note was written while holding the Mobilitas grant MJD 310.

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News

Fuzzy Set Theory: Graded logical approaches and their applications, 18–22 February

Since their inception in 1979, the Linz Seminars on Fuzzy Set Theory have emphasized the development of mathematical aspects of fuzzy sets by bringing together researchers in fuzzy sets and established mathematicians whose work outside the fuzzy setting can provide directions for further research. The philosophy of this seminar has always been to keep it deliberately small and intimate so that informal critical discussions remain central. LINZ 2014 was the 35th seminar carrying on this tradition and was devoted to discussing recent advances of graded logical approaches and their various applications. On this occasion there were six invited speakers (Stefano Aguzzoli, Gabriele Kern-Isberner, Didier Dubois, Anna Zamansky, Ioana Leuştean, and Rafael Peñaloza) who focused on both theoretical and applicative topics within the field of graded logics.

Stefano Aguzzoli, the first invited speaker, discussed a Stone-like duality between the categories of finite forests and of Gödel algebras (prelinear Heyting algebras). He also presented several consequences of this duality, namely he introduced a class of many-valued logics, which he identifies as "logics of forests", characterizing the free algebras of their associated varieties, a combinatorial classification of subvarieties, and a generalized notion of deterministic finite-state automata to cope with logic of forests rather than classical logic.

Gabriele Kern-Isberner presented an approach to belief revision from a point of view that offers natural methods for iterated revision and tackles the problem of multiple revision right from the beginning. This approach also takes the ideas of AGM as the starting point but investigates belief revision in richer epistemic structures like probabilities, or qualitative Spohn ranking functions, and offers a unified view.

Didier Dubois considered a simplified epistemic logic called MEL, whose syntax is a fragment of the modal logic KD and where an agent can express both beliefs and ignorance statements about propositional formulas. In particular he showed that a graded version of this epistemic logic generalizes possibilistic logic. He also considered dropping axioms K and D and moving to the MEL fragment of non-regular modal logics, this being the natural setting for encoding more general logics based on qualitative capacities viewed as imprecise possibilities. He also showed close connections to paraconsistent logics and to Belnap four-valued logics.

Anna Zamansky's talk dealt with the problem of inconsistent information in constrained databases. In her talk she considered recent approaches towards user-controlled inconsistency management policies. In this setting she presented work in progress aiming at developing a general theoretical framework for capturing context-aware inconsistency management, based on distance-based semantics and on the use of real-valued relevance degrees for incorporating user context and preferences.

Ioana Leuştean presented an excursion into probability in *luk* logic, i.e., state theory. Within this frame, Leuştean presented results about a dual categorical equivalence between state-complete Riesz MV-algebras and L-measurable spaces. Then she moved to present some consequences of this approach focusing in particular on conditional probability for *luk* logic and stochastic independence.

Rafael Peñaloza's talk focused on fuzzy description logics and how automata theory can be used to provide tight complexity bounds for reasoning in fuzzy description logics, in particular in fuzzy description logics based on Gödel calculus with both finitely-many or infinitely-many truth degrees. In this frame, due to the fact that Gödel logic conjunction is idempotent, he showed that the satisfiability problem is decidable, while it is undecidable for any fuzzy description logic based on a non-idempotent conjunction.

Besides the invited talks, and in order to maintain the traditional spirit of the Linz Seminars—no parallel sessions and enough room for discussions—thirty-one submissions were selected which, in our opinion, fitted best to the focus of this seminar. These regular contributions were grouped in different sessions during the four and a half days of the seminar, according to eight main topics: formal logic, categorical approaches to many-valued logics, modal logics and graded consequence relations, reasoning with inconsistency and similarities, fuzzy relations, fuzzy logical reasoning, uncertainty, and fuzzy set theory and applications. Also in the tradition of the Linz seminar, a round table was organized on Friday 21 February, where many participants contributed with lively discussions on several topics that had arisen during the seminar, mainly on the relationship between uncertainty, inconsistency and paraconsistency, and the suitability

of a categorial approach to fuzzy relations and truth degrees.

Tomasso Flaminio
Theoretical and Applied Science, Università dell'Insubria
Lluís Godo
IIIA, Spanish National Research Council
Siegfried Gottwald
Philosophy, Leipzig
Erich Peter Klement
Knowledge-Based Mathematical Systems, Linz

Functions, Proofs, Constructions, 21–23 February

The aim of the workshop was to bring together philosophers, historians, mathematicians and computer scientists to discuss questions such as: "Which kind of algorithms are proofs?", "Can the constructive notion of proof be fully grasped in terms of some notion of function?", "What is the distinctive feature of the class of inference rules among that of all possible operations?", "In which sense are the notions of proof and function impredicative and how does impredicativity manifest itself?", "Which are the identity conditions for proofs and functions?"

On Friday 21 February, Peter Schroeder-Heister depicted the state of the art of validity-based proof-theoretic semantics. By discussing several examples, he stressed the need for a characterization of what, in general, a reduction procedure is. By envisaging an original solution to the Kreisel-Goodman paradox, Walter Dean argued against the widespread mistrust in the Theory of Constructions as a foundation for intuitoinistic logic (joint work with H. Kurokawa). Yuta Takahashi clarified the sense in which Gentzen viewed his consistency proof for arithmetic as providing a finitist interpretation of implication. The main idea is to identify implications $A \supset B$ with sequents $A \Rightarrow B$.

In the afternoon, Thierry Coquand first discussed the need for a weak but still constructive notion of existence in type theory. Then he proposed to characterize weak existence using propositions, which are conceived as types with at most one element and whose definition relies on the identity type. Alberto Naibo traced the goals of Girard's Geometry of Interaction back to Kreisel's Theory of Constructions: both approaches view logical constants as expressing operations on mathematical objects belonging to a "type- and logic-free" domain. Anton Setzer and Reinhard Kahle showed that the impredicative construction of a Mahlo Universe in Martin-Löf Type Theory can be turned into a predicative construction in Feferman's Explicit Mathematics thanks to the availability in the latter setting of partial functions.

In several algebraic contexts, the characteristic axiom of certain kinds of ideal objects can be viewed as a variant of the disjunction property "$A \vee B = 1$ iff either $A = 1$ or $B = 1$". In many cases the axiom can be reduced via the Axiom of Choice to the trivial case in which $A = B$. Peter Schuster (partially joint with F. Ciraulo, N. Gambino and D. Rinaldi) investigated why this is so, and at which conditions a reduction by finite methods is possible. Stewart Shapiro reported ongoing joint work with G. Hellman and O. Linnebo aiming at an Aristotelian construction of the continuum, i.e., a construction

which makes no appeal to actual infinity. Giulio Guerrieri and Mattia Petrolo closed the morning session of Saturday presenting a natural deduction formulation for intuitionistic differential linear logic a (non-conservative) extension of linear logic in which the modality ! is governed by structural as well as co-structural rules.

In the afternoon, Stefania Centrone reconstructed the arguments advanced by Bolzano for the possibility of transforming any indirect proof (proof by reductio) into a direct proof. She exposed the weaknesses of Bolzano's arguments and the assumptions needed for parts of the arguments to go through. Mark van Atten presented an overview of Brouwer's conception of the Creating Subject, stressing the crucial role it has for Brouwer's intuitionism. Ryota Akiyoshi argued that the Bar Induction used by Brouwer in his demonstration of the Fan Theorem can be replaced by a version of Bucholz's Omega Rule.

On Sunday, Fritz Hamm gave some ideas of how to enrich the typed lambda calculus with a principle of acyclic recursion in order to develop a formal semantics for natural language capable of a fine-grained analysis of propositional attitudes. Gran Sundholm distinguished three notions of function: functions as dependent objects; functions as independent objects of higher level; and functions as independent objects of lowest level. To each conception a different notion of functional application has been associated. Dag Prawitz attacked the problem of how deductive inference can produce new knowledge. To solve the problem he proposed to take the performance of an inference as the execution of an operation which transforms grounds for the premises of the inference into grounds for its conclusion.

The workshop was organized by Luca Tranchini and Marco Panza and funded by the German Research Foundations with a contribution from the Division for Logic Methodology and Philosophy of Science.

Luca Tranchini
Logic, Tübingen University

Empirical Methods of Linguistics in Philosophy, 13–14 March

The method most often employed in experimental philosophy arguably is the questionnaire-based survey. Using such surveys in philosophy can serve a number of purposes. One is to supplement more traditional tools that analytic philosophers use in conceptual analysis. In linguistics, however, a variety of other (at least partially) empirical methods are available that philosophers could use towards similar as well as different purposes. This two-day workshop presented an opportunity to demonstrate the implementation of such methods in philosophical research, and to discuss further applications, benefits and limits of empirical methods adopted from linguistics.

On the first day, Aurélie Herbelot's (Cambridge) paper "Distributional Semantics for Philosophy" introduced three ways in which computational methods based on distributional semantics can be applied to philosophical topics: in discourse analysis, they can help identify social construction through the analysis of language use patterns in large corpora; in the history of ideas, they can assist in the analysis of the use of important concepts, e.g., by specific authors; and they may be used to evaluate philosophical the-

ories experimentally by testing their formalisation on ordinary language corpora. Shin Sakuragi (Shibaura Institute of Technology, Tokyo) demonstrated the use of questionnaire surveys for comparative purposes. His paper "Memory Expressions and Linguistic Methods" argued that the circularity charge levelled against the Lockean memory theory of personal identity is language-relative: it presupposes the expression 'to remember the feeling of V-ing' as opposed to 'to remember V-ing', but the formulation leading into circularity is not available in Japanese. Magdalena Sztencel's (Newcastle) paper "Reconciling Truth-Based Inference with Subjective Inference?" argued that utterance interpretation is wholly pragmatic, i.e., a wholly context-dependent process, rather than a process based on a context-independent decoding, followed by context-dependent inference. She supported her position with a discussion of a questionnaire study conducted by Sieghard Beller that examines the relation of the interpretation of conditionals to material implication.

On the second day, Anna Droždžowicz's (Oslo) paper "Speakers' Judgments about Utterance Content and How to Get Them" compared the verification task (suggested by Bart Geurts) and the truth-value judgment task (used by Stephen Crain and Cecile McKee) as two methods for obtaining speakers' judgments on utterance content. She argued that the latter is better suited to this purpose, since it can incorporate pragmatic facts, i.e., linguistic behaviour embedded in a context, and does not rely on theoreticians' pragmatic intuitions. Eugen Fischer's (East Anglia) paper "Psycholinguistics for Philosophy" discussed the application of experimental methods from psycholinguistics in cognitive epistemology. He described a variety of methods that may be used to test hypotheses posed to explain the intuitions driving the argument from illusion (e.g., sentence-completion, listing, plausibility-rating tasks, reading-time measurements, eye-tracking studies and ERP experiments), and he discussed findings from a pilot questionnaire study by Paul Engelhardt and himself. Finally, Barbara Vetter and Emanuel Viebahn (Humboldt University of Berlin) in their paper "How Many Meanings for 'May'?" demonstrated how findings from diachronic linguistics on the development of the meaning of modal expressions and cross-linguistic considerations can be brought to bear on a metaphysical debate regarding the interpretation of modal expressions.

The workshop also served to establish an informal network of researchers interested in the application of empirical methods of linguistics in philosophy. To join this group, please contact Roland.Bluhm@tu-dortmund.de.

Roland Bluhm
Philosophy, TU Dortmund University

Calls for Papers

Presuppositions: special issue of *Topoi*, deadline 15 May 2014.
Virtues & Arguments: special issue of *Topoi*, deadline 1 September 2014.

Uncertain Reasoning

The official history of fuzzy logic began in 1965 when Lotfi Zadeh introduced the concept of fuzzy set. He noted that

> more often than not, the classes of objects encountered in the real physical world do not have precisely defined criteria of membership.

Obvious as this remark might sound, the idea of investigating the properties of fuzzy membership was a genuine breakthrough. This is probably related to a sort of philosophical preconception which permeated logical thinking at the time and in one way or another persists to date. Namely the idea that truth is a binary notion. Sentences are either true or false. Of course it might be that we don't know whether a sentence is true or false. But then, the vast majority of logicians at that time would have recommended assessing the probability—not the degrees of truth—of the sentences in question.

Of course many-valued logic existed long before 1965 as a consequence of the pioneering work of Bochvar, Kleene and Lukasiewicz, among others. Those logicians, whilst developing the first many-valued truth-functional calculi (whose completeness was first proved in the mid 1950s), did not insist particularly on the "fuzzy" interpretation of their logics. Early work on many-valued logics is therefore best seen as a natural generalisation of two-valued, classical logic. This is no longer the case with Zadeh's introduction of the concept of a fuzzy set.

About two to three decades ago fuzzy logic was very popular, especially in artificial intelligence. Many saw it as a promising alternative to the probabilistic representation of uncertainty and its numerous applications instantly generated a widespread interest in the topic. By applications I don't mean the sort of use you can make of model theory in algebraic geometry. I mean washing machines which calibrate the amount of water and energy needed when your laundry is "small enough". By the early 2000s you couldn't buy a washing machine without fuzzy logic in it.

Yet, about that time, the logical interest in fuzzy logic seemed to be fading away. Some logicians felt the need to distance themselves from the more engineering-oriented part of fuzzy logic by stressing that their interest lay specifically with the notion degrees of truth. Some also suggested marking the distance by adopting the expression "mathematical fuzzy logic" instead of "fuzzy logic". A rendering of the contrast between the two fields is available, for instance, in this collaborative web project, which also contains some chapters of the state-of-the-art publication Handbook of Mathematical Fuzzy Logic.

In linking mathematical fuzzy logic to degrees of truth, reference is often made to the problem of vagueness. The idea is as follows. Whilst classical logic is restricted to the analysis of sharp or crisp concepts, many-valued logics provide a formal tool for reasoning with such concepts as "tall", "bald", "rich", which in ordinary parlance clearly

do admit of graded semantics. As far as I know this idea has received comparatively little endorsement from the philosophical community researching on vagueness. One explanation for this cold shoulder is the following. Under the interpretation that, say the infinitely many truth values of the interval $[0, 1]$ correspond to degrees of truth, one has the difficult task of considering $7/22$ and $1/\pi$ to be distinct truth values. The worry here is that to model vagueness with, say, Lukasiewicz infinite valued logic, one needs an enormously fine grain, which eventually ends up being more precise than anyone's discernment. And this seems to conflict rather fatally with the very idea of modelling vagueness.

I do not intend to discuss this problem here, but I think it's a serious one indeed. I'd rather like to report a recent interesting trend in justifying degrees of truth by mathematical, rather than philosophical argument. And one particularly popular approach is now to frame this in the context of enriched category theory. The popular blog The n-category café just dedicated a post to this topic.

The post is written accessibly and it links to related material which will help the uninitiated in category theory to appreciate the idea. Despite not being familiar myself with the (rather pictorial) language of categories, I think this is an interesting trend for it seeks to give the rather subtle notion of degrees of truth an independent mathematical standing, independent that is, of whether we think n grains make a heap. Moreover this brings back the talk of fuzzy logic to some of its initial motivations. Whilst Zadeh was intrigued by generalising membership to the $[0, 1]$ interval, the categorical approach looks essentially at generalising preorders. I cannot help but wondering what quantaloid-enriched washing machines will do for us in two decades from now!

Hykel Hosni
Marie Curie Fellow,
CPNSS, London School of Economics

Events

April

NAG: Norms, Actions, Games, London, 1–2 April.
AISB: 7th AISB Symposium on Computing and Philosophy: Is computation observer-relative?, Goldsmiths, London, 1–4 April.
HAPOP: History and Philosophy of Programming, Goldsmiths, University of London, 1–4 April.
D& MC: Deductive and Mathematical Cognition, Bristol, 7–8 April.
EBL: 17th Brazilian Logic Conference, Petrópolis, Brazil, 7–11 April.
PSX4: Philosophy of Scientific Experimentation 4, Pittsburgh, PA USA, 11–12 April.
PhiloSTEM: 6th Midwest Workshop in the Philosophy of Science, Technology, Engineering, and Mathematics, Fort Wayne, Indiana, 11–12 April.
Mathematical depth: University of California, Irvine, 11–12 April.
L & MS: workshop on Logical and Modal Space, New York, 11–13 April.

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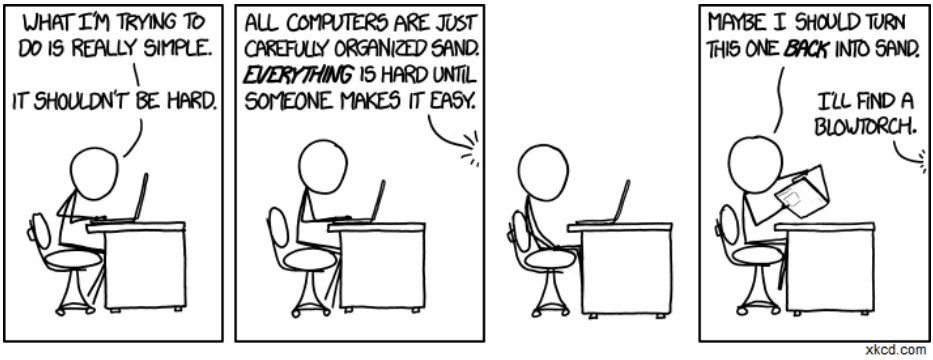
TAMC: 11th Annual Conference on Theory and Applications of Models of Computation, Anna University, Chennai, India, 11–13 April.
LMS: London Mathematical Society Lectures by Jouko Väänänen, London, 14–17 April.
SWANK: Stanford Workshop on Artificial Intelligence and Knowledge, Stanford University, 16 April.
PhML: Philosophy, Mathematics, Linguistics: Aspects of Interaction, St. Petersburg, Russia, 21–25 April.
PhDs in Logic: Utrecht, The Netherlands, 24–25 April.
MAICS: 25th Modern Artificial Intelligence and Cognitive Science Conference, Gonzaga University, Spokane, WA, USA, 26–27 April.

UConnLogic: Abstractionism / Neologicism, University of Connecticut, 26–27 April.
UK-CIM: UK Causal Inference Meeting (UK-CIM): Causal Inference in Health and Social Sciences, University of Cambridge, Cambridge, 28–29 April.
GIRLS: 3rd Conference on Games, Interaction, Reasoning, Learning & Semantics: Evolution and Cooperation, Lund, 28–30 April.
RSC: Research Students' Conference in Probability and Statistics, Nottingham, 28 April–1 May.
UK-CIM: workshop on Causal Inference, Graphical Models and Prediction in honour of A. Philip Dawid, University of Cambridge, 30 April.

May

LAMAS: 7th Workshop on Logical Aspects of Multi-Agent Systems, Paris, France, 5–6 May.
MSDM: Workshop on Multi-Agent Sequential Decision Making Under Uncertainty, Paris, France, 5–6 May.
SQUARE: 4th World Congress on the Square of Opposition, Pontifical Lateran University, Vatican, 5–9 May.
ADMI: 10th International Workshop on Agents and Data Mining Interaction, Paris, France, 5–9 May.
MS6: Models and Simulations 6, University of Notre Dame, 9–11 May.
EIDYN: Normativity and Modality, Edinburgh, 9–11 May.
Formal Methods: Singapore, 12–16 May.
WPI: 6th Workshop in the Philosophy of Information, Duke University, 15–16 May.
SLACCR: St. Louis Annual Conference on Reasons and Rationality, St. Louis, MO, 18–20 May.
Science & Metaphysics: Ghent, Belgium, 20–21 May.
Abstraction: Philosophy and Mathematics, Oslo, 21–23 May.
WFAP: Language and Philosophical Method, University of Vienna, 22–24 May.



ArgDiaP: 12th ArgDiaP Conference "From Real Data to Argument Mining", Warsaw, Poland, 23–24 May.
MAP: Mathematics, Algorithms and Proofs, Paris, France, 26–30 May.
FilMat: 1st International Conference of the Italian Network for the Philosophy of Mathematics, Milan, 29–31 May.
Formal Ethics: EIPE, Erasmus University Rotterdam, 30–31 May.

June

MSLP: Mathematising Science, University of East Anglia, 1–3 June.
F& MI: Fundamentality and Metaphysical Infinitism, University of Helsinki, Finland, 2–3 June.
ALGMATHLOG: Algebra and Mathematical Logic: Theory and Applications, Kazan, 2–6 June.
CWAP: Normativity of Meaning, Belief and Knowledge, Krakow, Poland, 4–6 June.
LogicMathPhysics: Ontario, Canada, 5–6 June.
TechnoCog: Innovation and Scientific Practice, Barcelona, 5–6 June.
POP: 4th LSE Graduate Conference in Philosophy of Probability, London, 6–7 June.
LG& M: Logic, Grammar, and Meaning, University of East Anglia, 7–9 June.
EC: 15th ACM Conference on Economics and Computation, Stanford University, CA, USA, 8–12 June.
MoT: Truthmaking as Grounding: For and Against, Barcelona, 9–10 June.
CCR: 9th International Conference on Computability, Complexity and Randomness, Singapore, 9–13 June.
Paraconsistency: Paraconsistent Reasoning in Science and Mathematics, Munich, Germany, 11–13 June.
IYSM: International Young Statistician Meeting, Universitá di Cagliari, Italy, 13–14 June.
COLT: 27th Annual Conference on Learning Theory, Barcelona, 13–15 June.
LOGICA: Hejnice, Czech Republic, 16–20 June.
SILFS: International Conference of the Italian Society for Logic and Philosophy of Sciences, University of Rome "Roma TRE", 18–20 June.
AMSTA: 8th International KES Conference on Agents and Multi-agent Systems—Technologies & Applications, Crete, Greece, 18–20 June.
FEW: 11th Annual Formal Epistemology Workshop, University of Southern California, Los Angeles, CA, 20–22 June.
SEP: 42nd Annual Meeting of the Society for Exact Philosophy, California Institute of Technology, Pasadena, CA, 22–24 June.
CiE: Computability in Europe, Budapest, Hungary, 23–27 June.
CaMaL: Causal Modeling & Machine Learning, Beijing, China, 25–26 June.
SPS: Metaphysics of Science, Lille, 25–27 June.
A & N: The "Artificial" and the "Natural" in the Life Sciences, University of Exeter, 25–27 June.
CogSciJR: Jagiellonian-Rutgers Conference in Cognitive Science, Kraków, Poland, 25–29 June.

SPE: Semantics and Philosophy in Europe, Berlin, 26–28 June.
&HPS: Integrated History and Philosophy of Science, Vienna, Austria, 26–29 June.
EGEC: 4th Annual Edinburgh Graduate Epistemology Conference, University of Edinburgh, 27–28 June.
IPSP: Imprecise Probabilities in Statistics and Philosophy, LMU Munich, 27–28 June.
EEN: European Epistemology Network Meeting, Madrid, 30 June–2 July.
FUR: 16th Conference on Foundations of Utility and Risk, Rotterdam, Netherlands, 30 June–2 July.

July

IACAP: Annual Meeting of the International Association for Computing and Philosophy, Thessaloniki, Greece, 2–4 July.
WCT: workshop on Computability Theory, Prague, 3–4 July.
YSM: Young Statisticians' Meeting, Bristol, 3–4 July.
Open Minds: University of Manchester, 4 July.
SotFoM: Symposium on the Foundations of Mathematics, Kurt Gödel Research Center, University of Vienna, 7–8 July.
CICM: Intelligent Computer Mathematics, University of Coimbra, Portugal, 7–11 July.
TiLXIV: Trends in Logic, Ghent University, Belgium, 8–11 July.
FLoC: 6th Federated Logic Conference, Vienna, 9–24 July.
BSPS: British Society for the Philosophy of Science, University of Cambridge, 10–11 July.
SIS: Scientific Meeting of the Italian Statistical Society, Cagliari, Italy, 11–13 July.
DEON: 12th International Conference on Deontic Logic and Normative Systems, Ghent, Belgium, 12–15 July.
SAT: 17th International Conference on Theory and Applications of Satisfiability Testing, Vienna, Austria, 14–17 July.
IPMU: 15th International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, Montpellier, France, 15–19 July.
LATD: Logic, Algebra, and Truth Degrees, Vienna, 16–19 July.
NMR: 15th International Workshop on Non-Monotonic Reasoning, Vienna, Austria, 17–19 July.
IJCAR: 7th International Joint Conference on Automated Reasoning, Vienna, Austria, 19–22 July.
CCA: Computability and Complexity in Analysis, Darmstadt, Germany, 21–24 July.
PAAR: 4th Workshop on Practical Aspects of Automated Reasoning, Vienna, Austria, 23 July.
PRUV: International Workshop on Logics for Reasoning about Preferences, Uncertainty and Vagueness, Vienna, Austria, 23–24 July.
AUAI: Uncertainty in Artificial Intelligence Conference, Quebec, Canada, 23–27 July.
KRC: Reasoning Conference, Konstanz, Germany, 24–27 July.
IJCAI: 24th International Joint Conference on Artificial Intelligence, Buenos Aires, Argentina, 25 July–1 August.
Causal Inference: Quebec, Canada, 27 July.

STARAI: 4th Workshop on Statistical Relational AI, Quebec, Canada, 27–28 July.
LOFT: Eleventh Conference on Logic and the Foundations of Game and Decision Theory, University of Bergen, Norway, 27–30 July.
UCM: Uncertainty in Computer Models 2014, University of Sheffield, 28–30 July.

August

AiML: Advances in Modal Logic, University of Groningen, 5–8 August.
ICPP: 13th International Conference on Philosophical Practice, Belgrade, 15–18 August.
CLIMA: 15th International Workshop on Computational Logic in Multi-Agent Systems, Prague, Czech Republic, 18–19 August.
ECAI: 21st European Conference on Artificial Intelligence, Prague, Czech Republic, 18–22 August.
DARE: International Workshop on Defeasible and Ampliative Reasoning, Prague, Czech Republic, 19 August.
ROBO-PHILOSOPHY: Aarhus University, Denmark, 20–23 August.
Hypo: Hypothetical Reasoning, Tübingen, Germany, 23–24 August.
SLS: 9th Scandinavian Logic Symposium, University of Tampere, Finland, 25–27 August.
ECAP: 8th European Conference of Analytic Philosophy, University of Bucharest, Romania, 28 August–2 September.

September

WoLLIC: 21st Workshop on Logic, Language, Information and Computation, Valparaiso, Chile, 1–4 September.
WPMSIIP: 7th Workshop on Principles and Methods of Statistical Inference with Interval Probability, Ghent, Belgium, 8–12 September.
COMMA: 5th International Conference on Computational Models of Argument, Scottish Highlands, 9–12 September.
ENPOSS: 3rd European Network for the Philosophy of the Social Sciences Conference, Madrid, 10–12 September.
GANDALF: 5th International Symposium on Games, Automata, Logics and Formal Verification, Verona, Italy, 10–12 September.
X-Phi: 5th Workshop of Experimental Philosophy Group UK, Oxford, 11–12 September.
LANCOG: workshop on Modal Syllogistic, Lisbon, 11–13 September.
SCLC: 10th Symposium for Cognition, Logic and Communication, University of Latvia, Riga, 12–13 September.
NoR& N: Nature of Rules and Normativity, Prague, Czech Republic, 17–19 September.
IWSBP: 11th International Workshop on Boolean Problems, Freiberg, Germany, 17–19 September.
ICTCS: 15th Italian Conference on Theoretical Computer Science, Perugia, Italy, 17–19 September.

EERG: Buffalo Annual Experimental Philosophy Conference, Buffalo, 19–20 September.
FOIS: 8th International Conference on Formal Ontology in Information Systems, Rio de Janeiro, 22–25 September.
KI: 37th German Conference on Artificial Intelligence, Stuttgart, 22–26 September.
JELIA: 14th European Conference on Logics in Artificial Intelligence, Madeira Island, Portugal, 24–26 September.
IEEE: Intelligent Systems, Warsaw, Poland, 24–26 September.
LANCOG: Workshop on Analyticity, Lisbon, 25–26 September.
Belief: 3rd International Conference on Belief Functions, Oxford, 26–28 September.

Courses and Programmes

Courses

MLSS: Machine Learning Summer School, Reykjavik, Iceland, 25 April–4 May.
Epistemic Game Theory: EPICENTER, Maastricht University, 12–23 May.
IGSAR: 2nd Interdisciplinary Graduate School on Argumentation and Rhetoric "Corpus Analysis in Argument Studies", Polish National Academy of Sciences, Warsaw, 21–24 May.
NASSLLI: 6th North American Summer School in Logic, Language and Information, University of Maryland, College Park, 21–29 June.
EASLLC: 3rd East-Asian School on Logic, Language and Computation, Tsinghua University, China, 2–8 July.
Carnegie Mellon: Summer School in Logic and Formal Epistemology, 2–20 July.
SIPTA: 6th SIPTA School on Imprecise Probabilities, Montpellier, France, 21–25 July.
MCMP: MCMP Summer School on Mathematical Philosophy for Female Students, Munich, Germany, 27 July–2 August.
ESSLLI: 26th European Summer School in Logic, Language and Information, University of Tübingen, Germany, 18–22 August.
CLPA: Summer School on Argumentation: Computational and Linguistic Perspectives on Argumentation, University of Dundee, Scotland, 4–8 September.

Programmes

APhil: MA/PhD in Analytic Philosophy, University of Barcelona.
Master Programme: MA in Pure and Applied Logic, University of Barcelona.
Doctoral Programme in Philosophy: Language, Mind and Practice, Department of Philosophy, University of Zurich, Switzerland.
HPSM: MA in the History and Philosophy of Science and Medicine, Durham University.
Master Programme: in Statistics, University College Dublin.
LoPhiSC: Master in Logic, Philosophy of Science & Epistemology, Pantheon-Sorbonne University (Paris 1) and Paris-Sorbonne University (Paris 4).

Master Programme: in Artificial Intelligence, Radboud University Nijmegen, the Netherlands.
Master Programme: Philosophy and Economics, Institute of Philosophy, University of Bayreuth.
MA in Cognitive Science: School of Politics, International Studies and Philosophy, Queen's University Belfast.
MA in Logic and the Philosophy of Mathematics: Department of Philosophy, University of Bristol.
MA Programmes: in Philosophy of Science, University of Leeds.
MA in Logic and Philosophy of Science: Faculty of Philosophy, Philosophy of Science and Study of Religion, LMU Munich.
MA in Logic and Theory of Science: Department of Logic of the Eotvos Lorand University, Budapest, Hungary.
MA in Metaphysics, Language, and Mind: Department of Philosophy, University of Liverpool.
MA in Mind, Brain and Learning: Westminster Institute of Education, Oxford Brookes University.
MA in Philosophy: by research, Tilburg University.
MA in Philosophy, Science and Society: TiLPS, Tilburg University.
MA in Philosophy of Biological and Cognitive Sciences: Department of Philosophy, University of Bristol.
MA in Rhetoric: School of Journalism, Media and Communication, University of Central Lancashire.
MA programmes: in Philosophy of Language and Linguistics, and Philosophy of Mind and Psychology, University of Birmingham.
MRes in Cognitive Science and Humanities: Language, Communication and Organization: Institute for Logic, Cognition, Language, and Information, University of the Basque Country, Donostia, San Sebastián.
MRes in Methods and Practices of Philosophical Research: Northern Institute of Philosophy, University of Aberdeen.
MSc in Applied Statistics: Department of Economics, Mathematics and Statistics, Birkbeck, University of London.
MSc in Applied Statistics and Datamining: School of Mathematics and Statistics, University of St Andrews.
MSc in Artificial Intelligence: Faculty of Engineering, University of Leeds.

MSc in Cognitive & Decision Sciences: Psychology, University College London.
MSc in Cognitive Science: University of Osnabrück, Germany.
MSc in Cognitive Psychology/Neuropsychology: School of Psychology, University of Kent.

MSc in Logic: Institute for Logic, Language and Computation, University of Amsterdam.
MSc in Mind, Language & Embodied Cognition: School of Philosophy, Psychology and Language Sciences, University of Edinburgh.
MSc in Philosophy of Science, Technology and Society: University of Twente, The Netherlands.
MRes in Cognitive Science and Humanities: Language, Communication and Organization: Institute for Logic, Cognition, Language, and Information, University of the Basque Country (Donostia San Sebastián).
Open Mind: International School of Advanced Studies in Cognitive Sciences, University of Bucharest.
PhD School: in Statistics, Padua University.

Jobs and Studentships

Jobs

Post-doc Position: in Set Theory, Torino University, until filled.
Assistant Professor: in Philosophy of Science, University of Amsterdam, deadline 4 April.
Lecturer: in Philosophy of Science, Bielefeld University, deadline 15 April.
Senior Lecturer: in Theoretical Philosophy / Philosophy of Science, Stockholm University, deadline 15 April.
Post-doc position: on the project "The Epistemology of Data-Intensive Science", Egenis, University of Exeter, deadline 29 April.
Post-doc position: on the project "Mathematics: Objectivity by Representation", Institut d'Histoire et de Philosophie des Sciences, Paris, deadline 30 April.
Post-doc position: on the project "Knowledge-First Virtue Epistemology", KU Leuven, Belgium, deadline 30 May.

Studentships

PhD position: in Theoretical Philosophy, Stockholm University, deadline 15 April.
PhD position: on the project "The Epistemology of Data-Intensive Science", Egenis, University of Exeter, deadline 29 April.
PhD position: on the project "Hybrid-Logical Proofs at Work in Cognitive Psychology", Roskilde University, deadline 9 May.
PhD position: on the project "Knowledge-First Virtue Epistemology", KU Leuven, Belgium, deadline 30 May.
PhD position: on the project "Influence in Cyberspace: The relationship between information provenance, trust and identity within the context of cyber influence", Web Science, University of Southampton, deadline 30 September.