The Reasoner

Volume 5, Number 9
September 2011

www.thereasoner.org
ISSN 1757-0522

Contents

§1 Editorial

It is a great pleasure for me to act, once again, as guest editor of an issue of *The Reasoner*.

This time I take advantage of this possibility to talk about an emerging discipline to which I have recently turned my attention, that is, systems biology.

Systems biology—I quote an authoritative source of common knowledge, viz. Wikipedia—is

> a term used to describe a number of trends in bioscience research, and a movement which draws on those trends. Proponents describe systems biology as a biology-based inter-disciplinary study field that focuses on complex interactions in biological systems, claiming that it uses a new perspective (holism instead of reduction). [. . .] An often stated ambition of systems biology is the modeling and discovery of emergent properties, properties of a system whose theoretical description is only possible using techniques which fall under the remit of systems biology.

This is all very intriguing, as it seems that systems biology offers a new, unconventional way to reason about biological systems. Yet, the above characterisation is also rather vague. The identity criterion of the discipline depends—I keep paraphrasing Wikipedia—on one or more of the following features:

- systems biology's own subject matter, viz. complex biological systems and interactions—but hasn't this been the subject matter of biology *simpliciter* all along?
- the peculiar, holistic rather than reductionist paradigm that systems biology advocates—but wasn't this idea already in the general systems theory of the 1960s?

- the use of new "operational protocols" for performing research, where hypothesis formulation and laboratory experiments are complemented with mathematical modelling and computation—OK, this is an original element, but there are analogous applications of the same tools to disciplines as diverse as physics (e.g., phase transition phenomena), epidemiology (e.g., pandemic diffusion) and finance (e.g., asset pricing); what's so special about biology?

- the application of dynamical systems theory to molecular biology—again, true, and yet there must be something more to systems biology, since dynamical systems theory has been applied to many other disciplines (see above), so what is special with biology?

- a "socioscientific phenomenon", having to do with integration of data, interdisciplinary tools and personnel—true, but such a socioscientific phenomenon is nowadays common to all academic research, with fewer and fewer researchers operating in isolation, whether in the sciences or in the humanities, so why erect this fact as distinctive feature of the systems biology community?

Perhaps the truth is a mix of all this. Still, I'm left somehow dissatisfied and with many unanswered questions which make my head spin. What *is* systems biology? What theoretical and practical changes is it responsible for? And what can philosophers do to clarify the conceptual foundations of systems biology, investigate its methodology and the nature of its subject matter? Luckily, I have the chance to ask these questions to a first-class systems biologist, Prof. Olaf Wolkenhauer—and perhaps make his head spin as well!? So, here we go, let the interview begin.

LORENZO CASINI
Philosophy, University of Kent

§2
FEATURES

Interview with Olaf Wolkenhauer

Olaf Wolkenhauer heads the Department of Systems Biology and Bioinformatics at the University of Rostock, Germany. Among other things, he holds an adjunct position in the Department of Electrical Engineering and Computer Science at Case Western Reserve University, is co-founder of the first international journal for *Systems Biology* and a fellow of the Stellenbosch Institute for Advanced Study (STIAS).

LORENZO CASINI: Hi Olaf, and thank you for accepting to be interviewed for *The Reasoner*.

OLAF WOLKENHAUER: Thank you!

LC: You have a background in control engineering, you hold a position in a department for biomolecular sciences, and you have a variety of interests, ranging from maths to philosophy of science. What, if at all, holds together all these subjects? Perhaps some skill that a good system biologist should possess?

OW: The glue between my interests is *systems theory*, to provide both a conceptual basis and a working method for the scientific explanation of biological phenomena. A good system biologist should possess a fascination for biology and, above all, (s)he requires persistence. A systems biology approach is an interdisciplinary approach, a collaboration of (at least) two experts from different fields of specialisation. Ideally, the collaborators work, with equal interest, together on *one and the same* research question, where either of them would have small or no chance to succeed separately. This is a crucial point—a blessing and a curse at the same time.

LC: There are plenty of projects out there that claim to apply a systems biology methodology. How would you define systems biology?

OW: My definition of systems biology is pretty much identical to a definition agreed upon by a large number of funding bodies across Europe (c.f., `http://www.erasysbio.net`). Systems biology aims at understanding the dynamic interactions between components of a living system, between living systems and their interaction with the environment. Biological questions are addressed through integrating experiments in iterative cycles with mathematical modeling, simulation, and theory. A difference is that I consider it an *approach*, not a discipline. Once systems theoretic approaches and mathematical modeling are widely accepted in the life sciences, I would not mind if the notion of "systems biology" disappears.

LC: What is the background and methodology of a system biologist? One could (provocatively) argue that systems biology is more a by-product of developments germane to other disciplines (e.g. dynamical systems theory, evolutionary computation) *as-applied-to* biology, rather than a development of biology proper. To what extent are systems biologists *biologists* rather than applied mathematicians or versatile computer scientists, physicists or engineers?

OW: You are right; to a large extent the current practice is to apply existing mathematical tools in a biological context. I do however believe that this is changing. Mike Mesarović described already in 1968 the situation that still exists: Theoreticians have to take a stronger interest in biological questions and biologists have to start asking questions that are based on systems-theoretic concepts.

Take for example cancer research, which could provide the stimulus for the development of new theory. Cancer is a process that involves individual cells whose behavior however is largely influenced by their environment. For problems of this kind, covering multiple scales (from cells to tissues) and multiple levels of functioning (from cell division to tissue physiology) we need new conceptual tools. Conventional mechanistic bottom-up modeling and numerical simulations won't take us far. The top level of complex biological systems is not only an emergent property of the lower levels but because there exists causation in both directions, one cannot study some lower-level subsystem in isolation from its environment and higher (spatio-temporal) levels. The theory of multilevel systems that exists needs further development, but what is already there is also not fully appreciated, yet.

Because, in my view, systems biology is not a discipline as such, there is also not really something like a 'systems biologist'. Systems biology is an interdisciplinary approach to answer biological questions. A range of expertise is required, designing experiments, analyzing data, building mathematical models, realizing computer simulations and developing theoretical concepts and computational tools. The common ground is, or should be, a biological research problem.

LC: What is systems theory, exactly, and why is it needed in biology?

OW: To me, systems theory is foremost a way of thinking and, rather than obtaining new facts, I consider it more interesting to discover new ways of thinking about them. Technological advances have been a driving force for the life sciences but we ought to realize that many barriers to progress have to do with the way we approach biological questions. Just as we need new devices for better measurements, we also need new methodologies to change the way we think about or understand biological complexity. For example, in my view the process of modeling is as important, if not more important, than a model itself. In modeling we need to identify observables, characterize system variables and speculate about how these could interact or interrelate. The difficulties of this process, and the apparent "failure" of models in this process, are in fact the real basis for a better understanding.

The purpose of a model is therefore not so much to fit the data, but to sharpen our questions. Like a good novel, it is the entire story that matters, not just the ending.

LC: What do you consider the main stumbling blocks for the application of systems theory, or a better understanding of biological systems in general? How do you try to address these difficulties?

OW: Biological complexity is the main hurdle for a better understanding of biological systems and hence the main reason why molecular and cell biology has to change. A living system is complex, not so much due to a large number and variety of components, but because (i) every aspect and component of a living system is subject to constant change and transformation (evolution being the underlying organizing principle); (ii) there are counterintuitive nonlinear relationships between variables interacting in space and time (counterintuitive phenomena that are also limiting the effectiveness of analytical and computational tools); and finally, which brings us to Immanuel Kant, (iii) living systems consist of multiple levels of organization, manifesting both regressive and progressive causality (underlying which is the principle of self-organization). Reciprocal interactions are particularly problematic because of their circular, self-referential character: In living systems, the whole is the product of the parts, but the parts in turn depend upon the whole for their own proper functioning and existence.

For example, in a tissue, every cell owes its presence to the agency of all the remaining cells, and also exists for the sake of the others and the whole (that is an organ). In a self-organizing system, such as an organ, the whole (tissue) and its parts (cells) reciprocally produce each other; determine the behavior and functioning of each other. This provides a challenge not only for experimentalists but also for modelers who quickly find Dynamical Systems Theory being rather limited when it comes to nonlinear, spatial processes to describe multiscale systems.

I am looking into Mathematical General Systems Theory, developed by Mesarović and Takahara in the 1970s, to provide both a conceptual basis and a working method for the study of multilevel systems. My goal is to identify cross-level relationships and ultimately organizing principles (which to me is the biological equivalent to a law of physics). This may appear more abstract to begin with but I am convinced that at the end there is nothing more practical than a good theory.

LC: You collaborate, among other people, with Mihajlo Mesarović, who contributed to the development of systems theory. What does systems biology inherit from him?

OW: I am very lucky to have worked with Mike. Right now we are in frequent email contact, discussing the role of theorems in the search for organizing principles in biology. He wrote in 1968 (!) an article entitled

"Systems Theory and Biology" which contains not only the first reference to the notion of "systems biology", but also a number of observations and recommendations that remain true to this day! He was and is right that we need to think beyond pathway-centric, mechanistic, quantitative modeling and dynamical systems theory.

Together with Yasuhiko Takahara he has produced the most comprehensive formal theory of systems. The success of differential equations in the physical and engineering sciences has meant that people consider such state-space approaches "the" way to model reality, when in fact this is only a special case of more general time systems. Reading their 1972 book in which they formulate their mathematical theory of general systems, I was shocked to find out that the notion of a state-space is only a secondary concept that derives from a much more general formulation. The principle limitation of conventional mechanistic modeling and numerical simulations within dynamical systems theory is that as the complexity of a system increases, our ability to make precise and yet general statements diminishes. This is particularly apparent in the current efforts in multiscale modeling. As an engineer, I was myself so firmly stuck in conventional dynamical systems theory, that for a long time I did not fully appreciate Mesarović's call for a different, non-numerical language of complexity.

Mike wrote, in 1968, "In spite of the considerable interest and efforts, the application of systems theory in biology has not quite lived up to expectations". We should worry whether this could not apply to systems biology in 2020 as well. The need to rethink biological complexity is obvious, to this day. This includes the fact that theory and applications are intimately related and none can make significant progress without the other.

LC: Among your sources of inspiration is also Robert Rosen. His idea that living systems are self-referential and closed to efficient causation as well as his 'proof' that living systems must have non-computable models have been quoted and discussed. Still, there seems to be more to Rosen's intuitions than we have so far appreciated. What have you inherited from him?

OW: I am fond of Rosen's critique that biological systems are simply a special case of physical systems. He has developed various ideas to demonstrate the complexity of biological systems and what make them special. Similar to Mesarović's work, I think Rosen's ideas deserve more attention. The big difference between the two is, however, that Mesarović has developed a comprehensive mathematical framework that enables a step-by-step analysis, while it is more difficult to follow some of Rosen's argument using mathematics. I subsequently gave up trying to understand "what Rosen really meant".

Mesarović demonstrated the constructive origin of a state space by developing a more general framework in which state-based models are only a special case. Rosen also realized the limitations that arise if one assumes a state-space (e.g. smooth manifolds), *a priori*. He suggested an alternative relational approach, in which there is some set of abstract states. The starting point for modeling is then a representation of the measurement process through observables. The state space is replaced by a set of mappings, instead of starting with a smooth manifold and then defining an algebra, one starts with an algebra of maps. Relational biology in the sense of Rosen thus describes entailment without states. In other words, rather than making assumptions about what the system under study is, in itself, one starts with a description of what can observe.

Rosen also demonstrated that closure to efficient causation is a defining characteristic of living systems and showed how the complexity of self-organizing or self-referential systems challenges us. Rather than trying to sell nature as being simpler than it is, promising unrealistic progress, I believe we should embrace biological complexity, accept it and find a language to describe it. Biological complexity is the source of the variety and beauty we find in nature. This should motivate us to invest more time and effort in understanding understanding.

LC: Certain philosophers complain that the special sciences lack proper laws—Mendel's laws perhaps being a notable exception. It looks to me that systems biologists aim to abstract robust generalisations, if not laws, from phenomena. Do you believe that systems biology will ever lead to the formulation of laws whose scope and strength are analogous to the those of the laws of physics?

OW: Yes, I am convinced that we will be able to formulate these "abstract robust generalizations", or 'organizing principles' as I prefer to call them. Organizing principles provide a deeper understanding of the behavior of a system—why it behaves the way it does in reality, independent from a particular manifestation of the system in the real world.

One problem is that we do not really look for organizing principles. We are so preoccupied with and drowning in molecular details that we miss the wood for the trees. The beauty of organizing principles is that if you're familiar with a principle you don't have to be familiar with all of its applications. This however requires methodologies to study categories of systems rather than particular exemplifications.

The search for organizing principles requires approaches different to what we have today—more abstract ones. In systems biology, we would have to break out of the current pathway-centric framework and mechanistic modeling that dominates systems biology to this day. The role of theorem proving is an example. Theorems play an important role in conventional systems theory (e.g., in stability analysis) but only "behind the scenes". For the formulation of organizing principles, however, we need non-numerical approaches like theorem proving to become accepted as scientific explanations in the life sciences.

Finding organizing principles is an order of magnitude more challenging than mechanistic modeling because they are rare and more difficult to justify. But as Mike Mesarović once told me "It is less frustrating not to catch a big fish than it is not to catch a small fish. We might as well ask the big questions".

LC: The nature of the projects that nowadays aim to pass as systems biology is rather heterogeneous. This can clearly affect the public's perception of this new field of research. How would you warn against the confusion engendered by the ubiquitous reference to systems biology in all these projects?

OW: I am not sure what the public's perception of the field is but I worry that even in the (life) sciences the understanding of why we need systems biology is equally poor as it may be in the public. A key point is that a systems approach, using systems theory to give an explanation of biological phenomena, is first of all a different way of thinking about the organization and behavior of biological systems. It is for this reason that the impact of systems biology approaches is also more difficult to measure. With new buzzwords coming and going, I am indeed worried that the need for a change in the way we tackle biological complexity is not sufficiently appreciated.

Not only do we have to convince the biological community to accept systems-theoretic explanations, we also have to convince the modelers that systems theory is not restricted to mechanistic modeling and dynamical systems theory. There is thus lots of scope to change the way people think about their research problems.

It is disappointing to see researchers relabeling their work as systems biology, without changing anything in how they work.

LC: People tend to have an idealised picture of science as a fast and reliable results-generating enterprise, and ignore that good quality research can be slow, and need not necessarily involve large-scale and expensive projects. What do you regard as exemplars of the accomplishments of interdisciplinary research and what lesson should science policy makers draw from such exemplars?

OW: To do mathematical modeling at the life sciences interface is to engage in an act of discovery and conjecture, intuition and inspiration. However, to paraphrase Winston Churchill, in systems biology, success is going from failure to failure without loss of enthusiasm. Discovery (of truly exciting results) is hard to accomplish and failure is frequent.

Surely, good research can come from small projects and the development of mathematical tools is certainly inexpensive compared to experimental research. Still, I would disagree with you. Achieving progress, say in understanding the cellular origins of a disease, requires the collaboration of many specialists from a range of disciplines spread across several locations. I don't think the life sciences can offer much in terms of success stories here.

The life sciences are a long way off from what physics achieved in terms of large-scale projects. The Large Hadron Collider (LHC) required decades of work, involves a very large number of scientists and institutes and cost billions. Compare this effort and investment to figure out whether the Higgs boson exists with the question of how cancer develops in a human body. The fact is that the largest possible project for cancer research in Europe will provide you with about 12 million Euros, for about three to five years. When they tried to launch the LHC, it broke down, the repair costing about 16 million Euros, more than what you can get to generate a breakthrough in treating some disease. Is there anyone who would argue that cancer is a simpler problem than the Higgs boson? Physicists have developed a culture in which large teams collaborate on a joint project. They don't do this because it is more fun than lonely brooding over a problem in the office, but because they won't be able to solve the problem otherwise. Pick a disease and you will find a need for similar efforts. The fact is, however, that there is neither the funding for such large scale efforts, nor is there any long term strategy to realize a truly comprehensive project to address any disease. The truth is that in collaborative life science projects most experimentalists do not dare to make themselves too dependent on other labs—the risk of failure (in terms of receiving further funding and generating publications) is considered too high.

A massive change in research culture is required to make real progress. Policy makers need to steer this process, otherwise necessary changes will not happen. Interdisciplinary research requires an extra effort on behalf of all sides, including strategic consideration for targeted research programmes and support for the initiation of cross-disciplinary collaborations.

LC: On a different note, what do Schopenhauer and, more in general, philosophy, have to do with systems biology? As a wanna-be philosopher of science, I'm intrigued by the reasons that drive a *scientist* towards philosophy. At what stage of their professional growth and for what reason do working scientists like you feel the need to interrogate philosophy to understand science, that is, their own domain of expertise? What kind of answer, if at all, can they find in philosophy?

OW: For a start, I am grateful to Schopenhauer for pointing out that there exist explanations; that knowledge based on reason is possible and that science therefore does make sense. We can establish truth, in the world of experience—hurray! His *principle of sufficient reason* is naturally the basis for the sanity and salary of scientists.

If you agree that what we can observe is not nature itself, but nature exposed to our method of questioning, then it makes sense not only to build models but to try to understand how we do this.

My interest in the philosophy of science and epistemology stems from the fact that scientific explanations biology is hampered by complexity and uncertainty. Despite the immense technological advances, we are still very limited to what we can measure and what we can handle mathematically, say, in the theory of nonlinear dynamical systems. There are thus practical, if not principle, limitations to what we can know. What we observe in biological experiments is not nature itself, but nature exposed to our method of questioning. *Data do not speak for themselves*, and it is not possible to conduct experiments without any implicit hypothesis or preconceived idea. For this reason it is worthwhile thinking about the way we think, perceive data, conceive ideas, understand and generate knowledge. Philosophers can help us with this.

LC: Why your interest in Schopenhauer in particular, and how do these ideas relate to systems theory, maybe Mesarović and Rosen as well?

OW: The common ground for my interest in Schopenhauer, Mesarović and Rosen is their 'relational perspective'. The aim of systems biology is not things (molecules, cells etc.) in themselves but the interactions and inter*relations* between things. For example, life is a relationship among molecules and not a property of any molecule (Linus Pauling)—there are living systems, there is no living matter (Jacob Monod). A consequence of this view is to give objects and relations between objects the same ontological status.

For living systems, the most interesting relations are whole-part relationships. In living systems, properties and behavior of every part of a system are largely determined by their function in the system as a whole. In a natural system this goes under the notion of 'self-organization' and when described formally, leads us to self-referential systems in mathematics. Biology, mathematics and philosophy meet at this point.

Schopenhauer's *principium individuationis* tells us that in the world of experience any object always and everywhere exists purely by virtue of another object. Schopenhauer distinguishes different principles of explanation, related to the class of objects one is dealing with. The definition that a system is (or reflects the existence of) a relationship between objects follows naturally. Mesarović starts with such a general definition but considered as a formal relation on families of sets. A complex system is then a relation on systems. My interest in mathematics is thus its very definition as a study of sets and relationships, including transformations between sets and their elements.

For Schopenhauer, causation is the *principle of explanation of change*; it is a relationship, not between things, but between changes of states of things . . . Does this not fit perfectly to a systems-theoretic approach?

According to Schopenhauer, understanding, through inference, is the subjective correlate of matter or causal entailment (which he considers one and the same). Understanding causal relationships is then the sole function of the understanding and its only power. Conversely, all causality and consequently the whole of reality, is only for the understanding, through the understanding, in the understanding. In systems theory understanding arises from transforming, abstracting one reality into another—through modeling. For complexity then, it is simplicity that is most interesting. With regard to modeling, simplicity is therefore the ultimate perfection.

LC: Thank you for answering my philosophical questions, Olaf. And thank you for practicing philosophical reflection yourself, which has made this interview all the more interesting—and my job a lot easier!

OW: Thank you. I hope my answers clarify my interest in philosophical questions and why a philosophy of systems biology actually could benefit from such discourse. I would urge philosophers of science not to wait until we have died, to only then analyze the work done and where we got it wrong.

Supplementing Belief Revision for The Aim of Truthlikeness

Within the last few years there has been some interest in investigating the relationship between the truthlikeness (verisimilitude) and belief revision programs. Two recent examples published in *EPSA Epistemology and Methodology of Science: Launch of the European Philosophy of Science Association* are Niiniluoto (2010: 'Theory Change, Truthlikeness and Belief Revision', *EPSA Epistemology and Methodology of Science*, Springer, 189-199) and Cevolani and Calandra (2010: 'Approaching the Truth via Belief Change in Propositional Languages', *EPSA Epistemology and Methodology of Science*, Springer, 47-62). Also, at the 2nd EPSA (European Philosophy of Science Association) conference a symposium titled 'Belief Revision Aiming At Truth Approximation' took place. Apparently a special issue of the journal Erkenntnis is also being dedicated to this topic.

One prominent result of this investigation is that given any plausible account of truthlikeness and rational account of belief revision, expansions (+) and revisions (*) of a database (or belief state) **D** with true input A are not guaranteed to increase the database's truthlikeness. **D** here is a belief set (i.e., **D** = Cn(**D**), the set of consequences of **D**) and D stands for its propositional formula representation.

Using the classic hot-rainy-windy example logical space found in the truthlikeness literature (Table 1. w_1

is the actual world and each possible world has probability $\frac{1}{8}$), two examples are given below. For the sake of example and without loss of generality, the truthlikeness function (Tr) used for calculations throughout this article will be the Tichy/Oddie average measure [see Oddie (1986: *Likeness to Truth*, D. Reidel)]. The constructive model of AGM belief revision used is that based on possible world modelling as outlined in Niiniluoto (2010: 196) [note: this corresponds to Dalal's update semantics.].

State	h	r	w
w_1	T	T	T
w_2	T	T	F
w_3	T	F	T
w_4	T	F	F
w_5	F	T	T
w_6	F	T	F
w_7	F	F	T
w_8	F	F	F

Table 1: Truth table for example logical space

Example

$D = (h \wedge \neg r \wedge \neg w) \vee (\neg h \wedge r \wedge w)$

$A = h$

$D + A = h \wedge \neg r \wedge \neg w$

$\mathrm{Tr}(D + A) < \mathrm{Tr}(D)$

Example

$D = h \wedge \neg r \wedge \neg w$

$A = (h \wedge r \wedge w) \vee (\neg h \wedge \neg r \wedge \neg w)$

$D * A = \neg h \wedge \neg r \wedge \neg w$

$\mathrm{Tr}(D * A) < \mathrm{Tr}(D)$

Thus, examples of decreases in truthlikeness are not hard to come by. In the first example it can be seen that the resulting increase in truth due to the input is offset by a greater decrease in truth somewhere else. In the second example, the original database content is closer to the completely false disjunct rather than the true disjunct, so minimal change favours selection of the former.

The possibility of true input decreasing truthlikeness is simply due to the fact that agents are accepting input under uncertainty and without knowledge of the complete truth (of course, if an agent already knew the complete truth then there would be no need to carry out belief revision).

These negative results prompt investigation into ways of supplementing the belief revision process with tools such as decision theory in order to make optimal decisions regarding the aim of increasing truthlikeness. To get the ball rolling on this matter, for the remainder of this article I would like to outline one simple idea, which combines non-prioritised belief revision with estimated truthlikeness calculations.

Screened Revision

With *non-prioritised* belief revision an agent weighs new input against the data it already holds and despite the input's novelty, it can be rejected (see Hansson 2009: 'Logic of Belief Revision', *The Stanford Encyclopedia of Philosophy* and Hansson 1999: 'A Survey of Non-Prioritised Belief Revision', *Erkenntnis*, 413-427). *Screened revision* (Makinson 1997: 'Screened Revision', *Theoria*, 14-23) extends the AGM framework and is one way to go about non-prioritised belief revision. It involves a set of potential core data **C** that is immune to revision. The database **D** is revised by the input A if A is consistent with the set $\mathbf{C} \cap \mathbf{D}$ of core data held by the agent; so with such a revision the elements of $\mathbf{C} \cap \mathbf{D}$ must remain.

An operation # on a database **D** is a *screened* revision if and only if:

$$\begin{aligned} \mathbf{D}\#A &= \mathbf{D} *_C A \text{ if } A \text{ is consistent with } \mathbf{C} \cap \mathbf{D} \\ &= \mathbf{D} \text{ otherwise} \end{aligned}$$

where using the Levi identity and defining revision in terms of contraction and expansion,

$$\mathbf{D} *_C A = \mathrm{Cn}((\mathbf{D} \div_C \neg A) \cup \{A\})$$

and $\div_C$ is a *contraction protecting* **C**: $\mathbf{D} \div_C A = \cap\gamma(\mathbf{D}\perp_C A)$, where $\mathbf{D}\perp_C A$ is the set of all maximal subsets of **D** that do not imply A but do include $\mathbf{C} \cap \mathbf{D}$ and γ is a selection function, as in standard AGM (see Gardenfors 1988: *Knowledge in Flux. Modeling the Dynamics of Epistemic States*, MIT Press).

Estimated Truthlikeness

The standard formula for expected utility in decision theory can be used to calculate the estimated truthlikeness of a statement A given prior evidence E (see Oddie 1986: 180):

$$\mathrm{Tr}_{est}(A|E) = \sum_{i=1}^{n} \mathrm{Tr}(A, S_i) \times \Pr(S_i|E)$$

n stands for the number of possible worlds in the logical space, S_i stands for the state description corresponding to world i and $\mathrm{Tr}(A, S_i)$ stands for the truthlikeness of A given the actuality of world i.

Combining Screened Revision with Truthlikeness Estimation

Agents could use a combination of screened revision and truthlikeness estimation to help them decide whether or not to accept input. Since **C** is immune to revision, it could be treated as knowledge and used as an evidential basis from which estimated truthlikeness calculations are made. A piece of input A would be accepted if (1) it does not conflict with $\mathbf{C} \cap \mathbf{D}$ and (2) the estimated truthlikeness of $\mathbf{D}\#A$ is greater than the estimated truthlikeness of **D**. Formally stated, the supplementary condition is:

$$A \in \mathbf{D}\#A \Rightarrow \mathrm{Tr}_{est}(D\#A|C) > \mathrm{Tr}_{est}(D|C)$$

Here is an example of this idea:

Example

$D = h \wedge (\neg r \vee \neg w)$

$C = h \vee r \vee w$

$\mathrm{Tr}_{est}(D|C) = 0.51$

Consider the inputs $A_1 = \neg h$ and $A_2 = r \wedge w$. Should the agent accept A_1? Should the agent accept A_2?

A_1 is compatible with C and $D\#A_1 = \neg h \wedge ((r \wedge \neg w) \vee (\neg r \wedge w))$. So $\mathrm{Tr}_{est}(D\#A_1|C) = 0.48$.

A_2 is compatible with C and $D\#A_2 = h \wedge r \wedge w$. So $\mathrm{Tr}_{est}(D\#A_2|C) = 0.57$.

Thus according to these calculations, the agent should accept A_2 but reject A_1. Furthermore, this method gives an easy way to compare two inputs. If an agent could select only one of many inputs, then they should choose that input which results in the greatest estimated increase.

Simon D'Alfonso
Philosophy, Melbourne

Algebra on chromosomal mutation: Emergence of a future discipline

This article focusses on the importance of the algebraic study of chromosomal mutations. Chromosomal mutations are variations of chromosome numbers or chromosome structure. The study of the subject leads to an algebraic formulation of the underlying mechanisms which is of considerable interest.

The human genome project (HGP) has changed the face of biology. The HGP was originally aimed at mapping the nucleotides contained in a haploid reference human genome, which number more than three billion. The objective of the HGP is to understand the genetic make-up of the human species. It remains one of the largest single investigational projects in modern science.

This large-scale DNA sequencing generated immense amounts of biological data. A large biological data set is now in our hands awaiting exploration. Large scale data management is unavoidable. In such a situation mathematics may play a major role in interpreting biological knowledge.

For centuries, there has been a separation of the two disciplines of mathematics and biology. This was the main hindrance to the understanding of biology through mathematical eyes. Recently, an interdisciplinary channel has evolved and there is huge scope therein to find mathematical structure in biological systems and data. In this context, it has been shown that algebra can play a very important role in understanding chromosomal mutation (D. Mazumdar, 2010: Mathematical models for biological sequence analysis, PhD Thesis, Visva-Bharati).

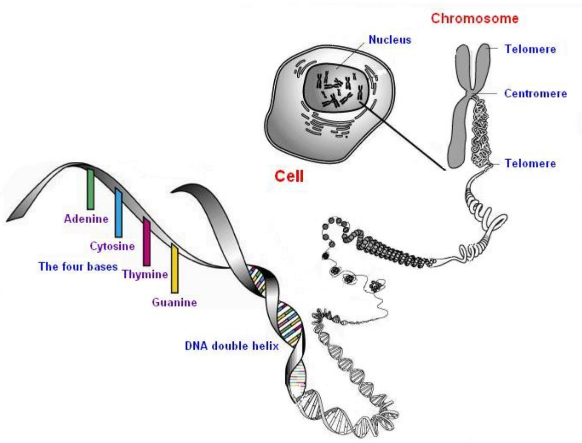

Figure 1: The cell and chromosome.

In the algebraic approach, Chromosomes are represented as mathematical sequences of finite length. Chromosomes are conceived as composed of a number of segments that are biologically significant. An algebraic structure is constructed for a given chromosomal string and a given segmentation. Let us consider an example. Suppose C is a chromosomal string comprising the nucleotides `a,t,g,c` and is such that $C =$ `atttgattacagatagaatagacagatagggatagacagat`. The segmentation Ψ is a biologically meaningful decomposition. For one such segmentation, for example, $\Psi_C =$ {`atttgattac`, `agatag`, `aat`, `agacagatagggat`, `agacagat`}, the composition of the segments returns the same string C that decomposed with Ψ (D. Mazumdar and S. Raha, 2011: An algebra for chromosomal mutation, *International Journal of Computer Mathematics*, in press).

A new algebra $\langle \Psi_C^*, *, ', \Delta, D \rangle$ can then be defined. The set Ψ_C^* is such that,

- $\Lambda \in \Psi_C^*$, Λ is the null segment;

- $\forall x \in \Psi_C, x \in \Psi_C^*$, and
- if $x, y \in \Psi_C^*$, then $x * y \in \Psi_C^*$, the binary operation $*$ being the concatenation operation defined as usual.

The structure $\langle \Psi_C^*, * \rangle$ can form monoids, i.e. $\forall a, b, c \in \Psi_C^*$, $a * b \in \Psi_C^*$; $a * (b * c) = (a * b) * c$; and $\langle \Psi_C^*, * \rangle$ possesses an identity.

The three unary operations induced by three mutational mechanisms are,
(i) The *involution operation* $\prime : \Psi_C^* \to \Psi_C^*$ such that, $\forall a, b \in \Psi_C^*$, $(a')' = a$ and $(a * b)' = b' * a'$.
(ii) The *deletion operation* $\Delta : \Psi_C^* \to \{\Lambda\}$ as $\Delta(x) = \Lambda$, $\forall x \in \Psi_C^*$.
(iii) The *duplication operation* $D : \Psi_C^* \to \Psi_C^*$ as $D(x) = x * x$, $\forall x \in \Psi_C^*$.

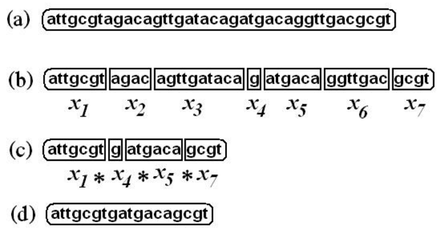

Figure 2: The concatenation of the chromosomal segments $x_1, x_2, \cdots, x_7$ of (b) makes the segment (a); The deletion of the segments x_2, x_3 and x_6 of (b) produces (c); The concatenation of the segments x_1, x_4, x_5, x_7 of (c) produces segment (d).

This algebra can, then, be regarded as an attempt to formalize the study of chromosomal mutations, or 'aberrations'.

Basic operations performed on the set of segments correspond to different chromosomal mutations, such as inversion, transposition, duplication, translocation, fission and fusion (D. Mazumdar, 2007: Chromosomal mutational algebra I, *Advanced Modeling and Optimization*, 9(2), 237–247; and (Preprint): Chromosomal mutation algebra: A new algebra to manipulate chromosomal mutation, Nature Preceedings).

Basic results can then be derived for the behaviour of the chromosomal segments. This may lead to a new method for understanding chromosomal mutation via mathematical models. For example, define $\widetilde{\Psi_C^*} \subseteq \Psi_C^*$, such that $\forall x \in \Psi_C$, $x^i \in \widetilde{\Psi_C^*}$, $(i = 0, 1, 2, \cdots)$ and if G is a semigroup (i.e., $\forall a, b, c \in G$, $a * b \in G$, $a * (b * c) = (a * b) * c$) with $a \in G$), then $H = \{a^n | n \text{ is an integer}\}$ is a cyclic semigroup of G generated by a. We get the following two results; (i) If $\Psi_C = \{c_1, c_2, \cdots, c_n\}$, then each $\langle < c_i >, * \rangle$, $1 \le i \le n$ is a cyclic semigroup and (ii) $\bigcup\limits_{1 \le i \le n} < c_i > = \widetilde{\Psi_C^*}$. Some elements of $< c_i >$, $1 \le i \le n$ are different tandem repeats (tandem repeats occur in DNA when a pattern of two or more nucleotides is repeated and the repetitions are directly adjacent to each other). They have different biological meanings and interpretations.

This may in turn open a new avenue to researchers to study diseases, their prevention, and the cure. This is because chromosomal abnormalities lead to diseases viz., cancer.

Different behavioural aspects of living organisms caused by chromosomal aberrations can also be studied theoretically.

Some chromosomal mutational mechanisms, such as insertion, are not included in Mazumdar's present work. Inclusion of these mechanisms would enrich the algebra. Other mechanisms, however uncommon, might also be included. As an example, if insertion is included then translocation may be defined by deletion and insertion. The monoid structure can also induce other structures, such as automaton. By inducing an inverse, as trivial inverse is not possible for the concatenation operation, the structure can also be improved upon mathematically, and lead to further important results.

Let us consider the DNA. DNA sequences lead to functions of proteins. Some particular DNA sequence encodes a particular protein. The stability of protein structure is a vital matter in functional level study. Suppose a string x leads to the formation of a particular protein and suppose that a sequence y reverses the function of the protein or breaks the protein structure, then in some sense y is an inverse of x. The newly formed mathematical structure, therefore, has the potential to contribute to a new line of research.

Mathematics, therefore, not only manipulates, but has the ability to predict new properties of biological activities. The mathematical study can drive us to find definite biological functions. This power may lead to a new direction in molecular biology. This approach is cost-effective and the beauty of the systematization of biological knowledge can be seen from different developments of the use of mathematical tools in biology.

Algebra itself is a very powerful tool in mathematics. A new algebra opens a new door to the ocean of knowledge and the proposed algebra may focus the development of a new discipline, in the manner of Boolean algebra.

Dipankar Mazumdar
Institute for the Integration of Knowledge, Asansol
Mathematics, Visva-Bharati, Santiniketan

§3 News

Horacio Arló-Costa

Horacio Arló-Costa, Professor of Philosophy at Carnegie Mellon University, passed away on July 14, 2011, at the age of 54. He is survived by Claudia Arló of New York, his wife and partner of thirty two years, and his mother, Arminda Costa, of Uruguay. Arló-Costa studied under some of the most important figures in formal epistemology, from Carlos Alchourrón during his undergraduate days in Buenos Aires to Isaac Levi and Rohit Parikh during his graduate days in New York. After earning his PhD in Philosophy from Columbia University in 1997, Arló-Costa joined the Department of Philosophy at Carnegie Mellon University, where he played an essential role in solidifying Carnegie Mellon's reputation as one of the very best places to do mathematical and scientific philosophy. During his career at Carnegie Mellon he served as either committee member or main advisor for several graduate students in the Logic, Computation and Methodology program. An enthusiastic and dedicated teacher, Arló-Costa taught a variety of courses during the academic year—from philosophical logic and rational choice to philosophy of science and philosophy of mind—and also taught in Carnegie Mellon's Summer School in Logic and Formal Epistemology. His most recent efforts in promoting formal epistemology were instrumental in creating Carnegie Mellon's Center for Formal Epistemology, where he served as Associate Director. A prolific and creative thinker, Arló-Costa made important contributions to several topics relevant to formal epistemology, from belief revision and epistemic conditionals to epistemic logic and Bayesian epistemology to normative and descriptive theories of decision making. He was also very active as an editor, serving for the Journal of Philosophical Logic, Review of Symbolic Logic, and Synthese, preparing multiple special issues, and assembling the highly anticipated Readings in Formal Epistemology (Cambridge University Press) co-edited with Vincent Hendricks and Johan van Benthem. Those who knew Horacio will remember him as not only a highly imaginative and passionate philosopher but also a kind and generous person. Information concerning various academic memorials to Horacio currently in the works can be found at *Choice and Inference*, a blog that Horacio had maintained with his student, Paul Pedersen, the blog's current administrator.

Jeffrey Helzner
Philosophy, Columbia University

Fictions in Science: Philosophical Essays on Modeling and Idealisation, edited by Mauricio Suárez, now in paperback

The paperback edition of *Fictions in Science: Philosophical Essays on Modeling and Idealisation* (London: Routledge 2009), edited by Mauricio Suárez, has just been announced. This compilation is a must for those interested in the interplay between science and fiction, and the launching of the paperback edition constitutes an excellent opportunity to explore the many proposals within its pages.

Most of the chapters of the book developed out of presentations and discussion at a small workshop held in Madrid on February 2006. At that time the nature of scientific representation was already a hot issue in the literature but the role of fictions in science had received very scant attention by philosophers of science. The workshop clearly had the merit of anticipating the now widespread interest in this latter topic and the resulting volume has the all the hallmarks of a pioneering work.

The challenge faced by the contributors of the volume is to understand why our best scientific models are plagued with fictive assumptions (assumptions that are known to be false of the system the model aims to represent) and often involve the postulation of entities known not to exist. The explanatory power of scientific fictions is also explored, as well as their bearing upon the realist/antirealist debate. Despite the novelty of the topic, there are a few illustrious precursors which include Arthur Fine's seminal paper "Fictionalism" (1993) reviewing and updating Hans Vaihinger's *Philosophy of "As if"* (1919). It has been an excellent decision to include that essay right after the editor's introduction. Following on that paper—and often in clear dialectics with it—the twelve remaining original essays (Rouse, Barberousse and Ludwig, Elgin, Bokulich, Morrison, Held, Suàrez, Winsberg, Ankeny, Knuuttila, Teller, Giere) add philosophical arguments and discuss fictionalism in more contemporary settings.

The most remarkable feature of the volume is its variety, which comes mainly in two ways. First, there is a large number of case studies explored, ranging from historical examples (Morrison's study of the mechanical theories of the ether) to absolutely contemporary cases (Winsberg discussion of models within nanomechanics and computational fluid dynamics) and covering not only physics (Bokulich; Suárez; Held) but also biology (Ankeny) and economics (Knuuttila). Second—and more importantly—variety also comes by means of the diversity of approaches to scientific fictions defended and of the paradigms influencing such approaches. To mention only three, Suárez addresses scientific fictions purely within his own inferentialist account of scientific representation, whereas Elgin relies on Goodmanian resources and Barberousse and Ludwig are inspired by

Walton's account of fictions as make-believe. No wonder that such a diversity of approaches results in unresolved disagreements regarding the scope of fictionalism in science. It is to be hoped that a second volume may be forthcoming in which the authors enter into further dialogue and contrast their competing views thus advancing further our knowledge of scientific fictions.

Albert Solé
Universitat Autònoma de Barcelona

Expressivism, Projection and Rules, 29 June–1 July

Expressivist accounts are often proposed for normative language (Ayer, Hare, Blackburn, Gibbard) as an alternative to descriptivist accounts leading to versions of realism and fictionalism. Some of the same reasons for endorsing expressivism about normative language carry over to modal language, broadly construed. But, at the same time, the dialectical situation there is also different, since the language of science is deeply modal. In this conference, we were interested to explore various arguments for and against expressivist and cognate views about modal language. We were also interested in ways that the modal case serves as a testing ground for the meta-theoretic issue of how best to think about anti-representationalist or anti-descriptivist accounts of an area of discourse. Here is a summary of the talks given at the conference, held at the Centre for Time at the University of Sydney.

Bob Brandom gave a paper called "Modal Expressivism and Modal Realism: Together Again" where he argued for a distinction between modal expressivism as a view about what one is doing in using modal language and modal realism as a view about what one is saying when one makes modal claims. So, construed, these are not only compatible but potentially mutually supporting.

Matthew Chrisman gave a paper called "Two Paths to Expressivism, and Beyond?" where he argued that two importantly different views have been run together under the label "expressivism" in metaethics and that these can be sharply distinguished and evaluated separately by considering their extension into modal and logical vocabularies.

Paul Horwich gave a paper called "Wittgenstein's Metaphilosophy" where he outlined several of the metaphilosophical and methodological tenets of Wittgenstein's later philosophy. In particular, he recommended a stance against "theoretical" philosophy which sacrifices commonsensical intuitions in favor of theoretical unity.

Jenann Ismael gave a paper called "Modality and the New Republican Realism" where she argued for a view of scientific model building that conceives of these models not as piece by piece representations of reality but rather tools for collecting, transforming, organizing, reformatting information for various practical tasks.

James Ladyman gave a talk called "What Should the Naturalist Make of the Modality of Science?" where he argued against metaphysical investigation into modal structures that is divorced from the concerns and progression of the natural sciences.

John MacFarlane gave a paper called "Relativism vs. Expressivism: The Case of Epistemic Modals" where he contrasted his relativist view of epistemic modals with Yalcin's expressivist view and argued that his view has certain attractive features.

John Maier gave a paper called "The Disunity of the Modals" where he argued that the case of the circumstantial modal 'can' provides important challenge to the orthodox view that modal words are operators on propositions.

Huw Price gave a paper called "'Here' is the Tip of the Iceberg: Generalised Indexicality and Metaphysics" where he argued that many more notions than we generally believe are covertly indexical in ways that undermine traditional metaphysical debate.

Greg Restall gave a paper called "Logical Constants, Sequent Structures and Speech Acts: The Case of Modal Operators" where he explained what it means to view modal operators as logical constants in certain contexts and what effect this has on debates in modal epistemology and ontology.

Mike Ridge gave a paper called "Expressivism: Flexible and Local" where he argued that expressivism in the normative case can stay local and doesn't have to give hostages to fortune and slide from local application into a global form of quasi-realist expressivism.

Lionel Shapiro gave a paper called "Relativism Without Relative Truth" where he argued that many of the cases where MacFarlane has argued for "assessment sensitivity" can be understood as such independently of relativism about truth.

Amie Thomasson gave a paper called "Modal Normativism: We Can Work It Out" defending her anti-descriptivist view of modal claims on the basis of the attractive answers it gives to various epistemological and methodological puzzles but also by responding to several apparent problems.

Michael Williams gave a paper called "Hume and Sellars on Physical Necessity" where he compared and contrasted the anti-representationalist views of causal necessity defended by Hume and Sellars, arguing that the latter makes important strides over the former.

Abstracts, audio, and slides for many of the papers are available through the conference's webpage.

Matthew Chrisman
Philosophy, University of Edinburgh

Vienna International Summer University, 4–15 July

From the 4th till the 15th of July, approximately 30 scholars from all across the world got together at the 10th Vienna International Summer University, a joint activity of the Institute Vienna Circle and the University of Vienna, in Vienna, Austria. The summer school has already managed to establish for itself a reputation for interdisciplinary tutoring, in memory of 'der Wiener Kreis'.

The topic of this year's two week program revolved around *The Nature of Scientific Evidence*. The main lecturers, Hasok Chang (Cambridge University), Tal Golan (University of California, San Diego) and David Lagnado (University College London), challenged the participants to rethink any concept of evidence they already had.

Hasok started out explaining the problems of induction. Is the emerald green or grue? And what about the white shoe, does it confirm that all ravens are black? David reconstructed the 'Sally Clark' case to show that jurors should be trained in Bayesianism to evaluate evidence. According to his approach, people are very capable of constructing causal stories, but bad at assessing the support for the story. Tal provided us with a historical approach to scientific evidence, by revealing a tight link between what happened in the 18th and 19th century courts and what was evaluated as good evidence or reliable expertise. After each lecture there was time for group discussion; needless to say that with an audience of 30 students from different origins and specializing in different subjects, the topics of the debates tended to be quite diverse. After four days of plenary discussions, the group unanimously decided to split up in three smaller groups to discuss more in depth questions.

During the second week, our opinions on the nature of scientific evidence were put even more to the test. After Hasok's lecture on measurement, questions were raised about accepting the results of careful experiments as evidence. Are measurements defined by the concept they're measuring or vice versa? Tal further pointed out that social values have a strong but difficult to decipher influence on what is accepted as evidence in legal and scientific contexts. Why is it that fingerprints were accepted, whereas polygraphs were not? David continuously urged us to think about the psychological aspect of evidence based reasoning and set up a framework of, what he called, Legal Lego. Softening his optimism driven by Bayesian applicability, he claimed that causality should be an important dimension of probabilistic reasoning.

In general, some interesting questions were spelled out that would otherwise not have been raised, such as 'What counts as a relevant fact?', 'Can the strength of evidence always be quantified?', 'What degree of probability is sufficient (for what purpose)?', 'Are explanations involved in evidential considerations?', 'How is the connecting of different kinds of laws (i.e., chemical, biological, sociological) supposed to happen?', 'Are we inclined to go Bayesian?'

Although there was a great diversity in the proposed answers, these two weeks served as an excellent opportunity to reason with people from different disciplines. This experience enabled us to engage in a special kind of dialogue, embodying Otto Neurath's appeal for cooperation as the only guarantee for fruitful results. We were part of a stimulating exercise in interdisciplinary reasoning that, in the end, turned out to be worth dodging any obstacles along the way. Last but not least, we would like to end with a personal note for the speakers, organisers and other attendees: 'Vielen Dank für diese wunderschöne Zeit zusammen!'

Laszlo Kosolosky
Merel Lefevere
Centre for Logic and Philosophy of Science,
Ghent University

Reasoning About Other Minds: Logical and Cognitive Perspectives, 11 July

On July 11th 2011 University of Groningen hosted the workshop "Reasoning about other minds: Logical and cognitive perspectives". It took place just before the TARK (Theoretical Aspects of Rationality and Knowledge) conference. Its main aim was to shed new light on social reasoning and "theory of mind" by investigating realistic cognitive resource bounds. The workshop was financed mainly by NWO through Vici Grant "Cognitive Systems in Interaction: Logical and Computational Models of Higher-Order Social Cognition" of Prof. Rineke Verbrugge.

The first invited speaker, Petra Hendriks, talked about bounded reasoning about others in language using the evidence from language acquisition. The second invited speaker, Chris Baker, talked about modeling human reasoning about beliefs, desires, goals and social relations with the use of inverse planning in the Bayesian setting.

The workshop consisted of three sessions of contributed talks and a poster session:

Influencing the knowledge of others. This session was devoted to some theoretical aspects of multi-agent information exchange. The first paper, titled "Common Knowledge in Email Exchanges", by Floor Sietsma and Krzysztof R. Apt, gave an account of epistemic agents communicating by means of emails, with the possibility of replies, forwards and blind carbon copies. The authors provided a characterization of a group of agents acquiring common knowledge of the fact that an email was sent. The second presentation of this session, "The Power of Knowledge in Games" by Rohit Parikh, Cagil

Tasdemir, and Andreas Witzel, was concerned with the relationship between knowledge and games - the authors described a knowledge manipulator whose aim is to affect other players' moves and to maximize her own payoff even while she herself remains inactive.

CHILDREN AND ADULTS TRYING TO APPLY THEORY OF MIND. Sujata Ghosh's and Ben Meijering's talk titled "On combining cognitive and formal modeling: a case study involving strategic reasoning" focused on the empirical studies on the so-called marble-drop game. In their paper they proposed a formal system that can model different strategies employed by the participants in the empirical study and therefore aid in building up a computational cognitive model of the participants reasoning in the game. The next talk, by Bart Hollebrandse, Angeliek van Hout and Petra Hendriks, was also concerned with empirical work, this time on first and second-order false-belief reasoning and how language supports reasoning about the beliefs of others.

IS REASONING ABOUT OTHER MINDS FEASIBLE. The last session consisted of two talks on the complexity of second-order reasoning. The first paper, "On the Tractability of Comparing Informational Structures" by Cedric Degremont, Lena Kurzen, and Jakub Szymanik gave an account of a mapping of the tractability border among the epistemic tasks. The authors goal was to identify a theoretical threshold in the difficulty of reasoning about epistemic information. In the talk "The Advantage of Higher-Order Theory of Mind in the Game of Limited Bidding" Harmen de Weerd and Bart Verheij made use of agent-based models to investigate the advantage of applying a higher-order theory of mind among agents with bounded rationality in the competitive setting of the limited bidding game, and describe how agents achieve theory of mind by simulating the decision making process of their opponent.

POSTER SESSION. In "An Argument for an Analogical Perspective on Rationality & Decision-Making" by Tarek Besold, Helmar Gust, Ulf Krumnack, Ahmed Abdel-Fattah, Martin Schmidt, and Kai-Uwe Kuehnberger, it was argued that the analysis and modeling of rational belief and behaviour should also consider cognitive mechanisms like analogy-making and coherence maximization of the background theory. In "The developmental paradox of false belief understanding: a dualsystem approach", Leon de Bruin and Albert Newen explored some aspects of the developmental paradox of false belief understanding. In "The Ditmarsch Tale of Wonders" Hans van Ditmarsch gave an account of the logic of lying public announcements. Last but not least, in "A Dynamic Analysis of Interactive Rationality" Eric Pacuit and Olivier Roy proposed a general framework for viewing informational contexts as the fixed-points of iterated, "rational responses" to incoming information about the agents' possible choices.

All papers have been published in CEUR Workshop Proceedings, available online.

NINA GIERASIMCZUK
Faculty of Mathematics and Natural Sciences,
University of Groningen

Theoretical Aspects of Rationality and Knowledge, 12–14 July

The mission of the bi-annual TARK conference is to facilitate the interaction between researchers working in logic, computer science, economic game theory and decision theory that share an interest in the study of rationality and knowledge. TARK aims at building bridges between topics and people, and has helped identify and shape new areas of research in various instances. Prominently, multi-agent epistemic logic in the style of Fagin, Halpern, Moses and Vardi "co-originated" with TARK in the 1980s, and its impact on computer science and economics remains visible today. More recent work built on these foundations—e.g., one of the seminal papers in dynamic epistemic logic, "The Logic of Public Announcements, Common Knowledge and Private Suspicions" by Baltag, Moss and Solecki, was first presented at TARK 1998.

In this way, TARK is certainly one of the best conferences to attend for getting a glimpse of emerging topics in this interdisciplinary field. This year's TARK, held at the University of Groningen from July 12 to 14, was no exception in this regard (the full proceedings of TARK 2011, covering much more ground than is possible to report here, are available at `http://tark.org`). The strengthened ties between the TARK community and social choice theory, e.g., were documented in a full afternoon session, and also in the award of the best paper prize to Noga Alon, Felix Fischer, Ariel Procaccia and Moshe Tennenholtz for their contribution "Sum of Us: Strategyproof Selection from the Selectors".

In their paper, Alon et al. discuss the problem of approval voting. An instance of this problem is committee selection: each member of a group approves a set of candidates taken from the ranks of the group itself, and a suitable function determines the "approved" candidates on the basis of the individual choices. A natural aim is to select the "best" agents, i.e., those approved by the highest number of other agents. On the other hand, one wants the selection mechanism to be "strategy-proof": no agent should be able to improve her own chances of being selected by changing the set of agents she approves herself. There is a tension between the two criteria, since an agent might, e.g., select fewer other agents, thus potentially improving her own chances. The paper by Alon et al. discusses how this tension can be partially resolved by means of what is called "approximate mechanism design".

The TARK conferences are also places where, in the frame of the prestigious invited TARK lectures, leading figures in the field discuss their research agenda, and introduce the audience to new perspectives on common themes. This year's speakers where Johan van Benthem, Yossi Feinberg, Itzhak Gilboa and Larry Moss. Van Benthem's talk aimed at exploring a "Theory of Play", a theory that would interface logic and game theory and provide an account of how actual agents think and act, based on, e.g., their computational limitations and belief revision policies. Feinberg discussed strategic communication between agents in a game-theoretic setting, using logical techniques stemming from the multi-agent epistemic logic tradition mentioned above. Gilboa surveyed the challenges decision theory faces more than fifty years after its inception, in an environment of changing methodologies and more diverse applications: "What would be a right mix of axioms and theorems, questionnaires and experiments, electrodes and fMRIs?" Moss, finally, presented coalgebra as a general mathematical framework suitable for unifying the various semantic models—Kripke models, type spaces, various types of automata—used in the TARK community to address issues like uncertainty in multi-agent settings, higher-order beliefs, actions that change the model and the players' beliefs.

Ben Rodenhäuser
Artificial Intelligence, Groningen

Quantum Physics Meets TARK, 15 July

The special session entitled "Quantum Physics meets TARK" was opened by Samson Abramsky's invited lecture, in which he presented a sheaf-theoretic approach to non-locality and contextuality. He defines a "sheaf of events" in terms of sections of measurement outcomes over a space of measurements on which covers are given by jointly performable combinations of measurements. This provides a general framework (that encompasses, but does not presuppose, a quantum-mechanical setting) for analyzing non-locality, contextuality and other related notions; for instance, it characterizes non-locality and contextuality as obstructions to the existence of global sections.

Pierfrancesco La Mura presented joint work with Adam Brandenburger which provided a purely information-theoretic description of quantum mechanics. They observe that Wigner's quasi-probability distribution, which can describe all the observable behaviors of a quantum system, is characterized in terms of complex entropy, a new notion they obtain by naturally extending Shannon's axioms of entropy to complex functions. These notions enable them to formulate, in purely information-theoretic terms, certain assumptions from which the equations of quantum mechanics can be derived.

The next two talks concerned applications of formal tools employed in quantum physics to other subjects.

Larry Moss presented a work of Jerome Busemeyer and Jennifer Trueblood in which they show that quantum probability theory can be applied to modeling human cognition and decision making. Citing both theoretical reasons and experimental data, they argue that a person's cognition or judgment shows a formal behavior similar to quantum phenomena such as superposition, measurement sensitivity, entanglement, etc., that can be better captured by quantum as opposed to classical probability.

Mehrnoosh Sadrzadeh, in her joint work with Edward Grefenstette, Stephen Clark, Bob Coecke and Stephen Pulman, showed an application of compact closed categories, along with their formulation in terms of quantum picture calculus, to natural-language grammar and semantics. This enables us to represent meanings of words or sentences in terms of vectors and linear maps, while maintaining a compositional approach to grammar. Experimental data indeed show that this application can be implemented to aptly disambiguate verbs.

The other invited lecture was given by Brandenburger. In this joint work with La Mura, he discussed what difference quantum information makes to decision theory. After noting how classical and quantum signals are represented on a decision tree, Brandenburger proves that quantum signals can (while classical ones cannot) make up for memory limitation on imperfect-recall Kuhn trees, making a strictly better strategy available to a decision maker who has access to quantum signals than to one with access only to classical signals.

Peter Hammond introduced a new notion of a laboratory game and proposed, as a player of the game, what he called an Experimenter, who chose, in a quantum setting, an orthonormal basis of a complex (separable) Hilbert space. He also showed how to suitably define probability and likelihood over the unit sphere of a Hilbert space. Thus, quantum behavior can be described within the framework of Kolmogorov probability and Bayesian decision making, without any help of non-standard probability or quantum logic.

In the last presentation of the session, Yohan Pelosse presented a kind of three-valued Kripke semantics that described each player's epistemic process through which (s)he reached a Nash equilibrium in a game. Using this setting, Pelosse derives two results, one on how Nash equilibria can be characterized by the players' epistemic states, and the other on how, in a Nash equilibrium, each player's epistemic states show the same structure as quantum states.

Kohei Kishida
Multi-agent Systems Group, ALICE Groningen

Social Choice and Artificial Intelligence, 16 July

The IJCAI-2011 Workshop on Social Choice and Artificial Intelligence aims at collecting the latest developments in the multidisciplinary areas of Computational Social Choice and Algorithmic Game Theory. Social Choice Theory studies procedures for collective decision making, such as elections, allocations of a set of resouces, and matching problems. Artificial Intelligence traditionally provides compact representations of preferences and studies the computational complexity of such problems. On the other hand, many of the topics that are now widely studied in AI such as page ranking or on-line recommendation systems are modeled and studied using classical results from Social Choice Theory.

After a warm welcome by the organisers Edith Elkind, Ulle Endriss and Jérôme Lang, the workshop started with a session showing advances in the area of coalitional games and moved on to the study of collective decisions, with a particular focus on interaction. A new simple model of quorum games was put forward by Julian Zappala et al., to model situations in which a group of individuals have to reach a certain quota of participants before performing an action. In the same line, a more refined study of how individual decisions are influenced by other decision members was analysed by Brent Venable et al., using CP-nets enhanced with a set of conditional influence statements to model individual preferences on a combinatorial domain.

The structure of voting coalitions was investigated by David Pennock and Lirong Xia, who concentrate on the hierarchical pivotal structure of a profile of linear orders, and propose a new version of random dictatorships based on this notion. Matching problems and fair division were well represented in the programme, as well as studies of computational complexity in voting theory. If the high computational complexity of an election, a classical result in the analysis of voting procedures, has been claimed to be an insufficient barrier against manipulation, then the Venetians would not agree, as Toby Walsh at al. found out by studying the election procedure of the Doge in 8 rounds varying at every step the size and the composition of the electorate.

In an interesting statement paper, Craig Boutilier and Tyler Lu advocate the intervention of other techniques from AI in the study of social choice mechanisms. These techniques are inspired by shifting the focus from classical problems with high stakes and low frequency such as elections, to more frequent choice problems in which less is at stake. Such problems arise from various applications such as on-line commerce, recommender systems or search engines. They propose four broad categories and several research challenges to analyse these problems, especially in the development of new probabilistic models for preference learning and in the optimisation and approximation of the result of partial elections.

Various talks on manipulation and tournaments gave a detailed overview of the latest developments in this area, and closed the workshop. A diversity of tapas under the salty sky of Barcelona closed an equally diverse and tasty day.

Umberto Grandi
Institute for Logic, Language and Computation,
University of Amsterdam

Levels and Causation in Neuroscience, 21–22 July

The workshop "Levels and Causation in Neuroscience" took place on July 21-22 at the Hanse Institute for Advance Study (HWK) in Delmenhorst, Germany (organizers Markus Eronen and Vera Hoffmann-Kolss). The aim of the workshop was to seek answers to the following questions: (1) In what sense does research and explanation in neuroscience involve several distinct levels? (2) How should we understand higher- and cross-level causation in neuroscience? The focus was on the recent interventionist theory of causation, prominently proposed and defended by James Woodward, and the mechanistic approach to neuroscientific explanation, whose major proponents include William Bechtel, Carl Craver and Bob Richardson.

The first day started with the keynote talk of James Woodward. According to his interventionist account, causation is seen as a matter of difference-making and manipulation and control, and not as a matter of physically producing the effect. Woodward (among others) has earlier argued that with this understanding of causation, psychological causes are not excluded by corresponding lower-level causes and hence Kim's causal exclusion problem can be avoided. In his talk, Woodward defended the interventionist solution to the exclusion problem against recent criticism. He also presented new ways of dealing with supervenience relations in causal modelling.

The following two speakers (Michael Baumgartner and Vera Hoffmann-Kolss) argued for exactly the opposite. They aimed at showing that the causal exclusion problem remains a problem also in the interventionist framework. Baumgartner argued that all the different ways of interpreting higher-level causes in the interventionist framework are either incompatible with nonreductive physicalism or problematic in other ways. Hoffmann-Kolss showed that some of the background assumptions in the interventionist solution to the exclusion problem (such as proportionality and supervenience) lead to problems when taken together. Continuing on the issue of interventionist causation and levels, Jaakko Kuorikoski argued in his talk that many of the problems can be dissolved if we understand that - contrary to what many authors assume - causation does not happen "at a level".

The second day started with the keynote talk of William Bechtel, who pointed out that more attention has to be paid to an aspect of research in neuroscience that he calls "reconstituting the mechanism", that is, seeking different ways how the components of the mechanism could be organized into a functioning whole that produces the phenomenon of interest. Raphael van Riel argued that levels and higher-level causes should be interpreted epistemologically, not ontologically, and this is how various problems can be avoided. Finally, Markus Eronen and Robert Richardson pointed out that an issue that has been largely neglected is how to identify levels of organization and how we can know that we have discovered a level. They suggested that one possible criterion for a level is robustness: levels are found where independent considerations (anatomical, structural, and functional) converge.

In general, the talks given at the workshop sparked lively discussion and pointed to a number of topics and problems that need further attention.

Markus Eronen
Vera Hoffmann-Kolss
Institute for Cognitive Science, University of Osnabrück

The Classical Model of Science II, 2–5 August

The conference *The Classical Model of Science II: The Axiomatic Method, the Order of Concepts and the Hierarchy of Sciences from Leibniz to Tarski* (Faculty of Philosophy, VU University Amsterdam, The Netherlands, 2-5 August 2011) was devoted to the development of the axiomatic method. It aimed to provide a better historico-philosophical understanding of the manner in which the axiomatic ideal of scientific knowledge influenced the development of modern science. The overarching framework of the conference was the so-called "Classical Model of Science" (CMS), an interpretative model aiming to capture a historically highly influential ideal of axiomatic science.

The contributions (8 invited and 20 contributed) concentrated on various historical periods and highlighted the use and articulation of axiomatic ideals of science in philosophy, logic, mathematics and natural science.

Several papers focused on ideals of axiomatic science as articulated in ancient philosophy. For example, Bernardo Mota argued that the axiomatic structure of the received text of the first book of Euclid's *Elements* was partly forged by Epicurean critiques of propositions contained in original versions of this book, while Marije Martijn presented an original overview of Neoplatonic views on the subordination of sciences.

Conceptions of axiomatic science as developed by modern philosophers were also treated in multiple papers. Eric Schliesser put forward the provocative thesis that Spinoza was critical of axiomatic methods in science insofar as he was skeptical about mathematical physics and adopted a holistic conception of scientific method. Katherine Dunlop showed how Christian Wolff took mathematical definitions and demonstrations to be partly based on experience, while Lisa Shabel reconstructed Kant's theory of geometry in terms of the CMS and showed how the often neglected regressive argument in the *Prolegomena* supports Kant's view that mathematical knowledge is based on pure intuition.

Turning to the 19th and 20th century, Paul Rusnock highlighted Bolzano's *Theory of Science*, emphasizing Bolzano's pragmatic views on science from his Theory of Method. Patricia Blanchette contrasted Frege's axiomatics to that of Dedekind and Hilbert, stressing the importance of the role of Fregean senses in this debate. By drawing upon the legacy of Leibniz's *characteristica* in the works of Grassmann, Peano and Gödel, Paola Cantù suggested viewing condition 2 of the CMS as containing variables. Paolo Mancosu showed how methodological issues of purity ideals in mathematical proofs informed discussions on the relationship between plane and solid geometry, insisting on the problematic relationship between the idea of contentless axioms and ideals of purity in Hilbert-style axiomatics. Hourya Benis Sinaceur gave an overview of Tarski's axiomatic views, stressing a three-fold distinction between concrete, abstract and formal axiomatics. Stewart Shapiro focused on the notion of *Zermelo self-evidence* according to which a proposition or inference is self-evident if it is applied unreflectively in a variety of instances, defending the suitability of this notion for non-foundational , holistic epistemologies of mathematics.

The conference was supported by the European Research Council and the KNAW. For more information, see the conference website.

Hein van den Berg
Philosophy, VU University Amsterdam

Calls for Papers

Deontic Logic: special issue of *Journal of Logic and Computation*, deadline 1 September.

Extended Cognition and Epistemic Action: special issue of *Philosophical Exploration*, deadline 15 September.

20 Years of Argument-based Inference: special issue of the *Journal of Logic and Computation*, deadline 1 October.

Re-Thinking Creativity: special issue of *Tropos: Jour-*

nal of Hermeneutics and Philosophical Criticism, deadline 15 October.

AILACT Essay Prize: to the best paper on teaching/theory of informal logic, critical thinking, or argumentation theory, with publication on *Informal Logic*, deadline 31 October.

The Alan Turing Year: special issue of *Philosophia Scientiæ*, deadline 1 November.

Between Two Images. The Manifest and the Scientific Understanding of Man, 50 Years On: special issue of *Humana.Mente*, deadline 30 November.

Psychological Models of (Ir)rationality and Decision Making: special issue of *Synthese*, deadline 1 December.

Scope of Logic Theorems: special issue of *Logica Universalis*, deadline 24 December.

Structure of Scientific Revolutions: 50 Years On: special issue of *Topoi*, deadline 15 January.

Imprecision in Statistical Data Analysis: special issue of *Computational Statistics & Data Analysis*, deadline 30 January.

Formal and Intentional Semantics: special issue of *The Monist*, deadline 30 April.

The Mind-Body Problem in Cognitive Neuroscience: special issue of *Philosophia Scientiæ*, deadline 1 May.

The Aim of Belief: special issue of *Teorema*, deadline 15 September 2012.

§4

What's Hot in . . .

. . . Logic and Rational Interaction

The European Summer School on Logic, Language and Information (ESSLLI) brings together students and researchers from all over the world, interested in interdisciplinary research at the interface of the three disciplines. This year's *ESSLLI* took place in August in in Ljubljana, Slovenia. As part of each ESSLLI, young researchers have the opportunity to present their work in a dedicated, peer-reviewed sessions, offering a glimpse of what the next generation of interdisciplinary researchers is up to. Contributions range over a broad variety of topics—the role of reinforcement learning in language evolution, modal definability, cycles in answer-set programming, politeness and trust games, and models of semantic competence, to name a few examples from this year's program. The proceedings of the student session are available *online*.

LORIWEB invites everyone to submit news relevant for the Logic and Rational Interaction community, such as workshop announcements, reports about past events, or published papers. Please contact Rasmus Rendsvig, our web manager or write to the loriweb address.

Ben Rodenhäuser
Artificial Intelligence, Groningen

. . . Mind and Cognition

Festival season is well under way in the city of Edinburgh, and the philosophy department is currently wedged between a BBC broadcasting stage and a purple cow. As the punters crowd to see their favourite performers, it seems appropriate for this month's hot topic to be *joint attention*, our ability to attend to an object or event, whilst being mutually aware of another's attention to that same object of event. Why is joint attention such an interesting phenomenon? One reason is that joint attention is pre-requisite for being able to engage in certain collaborative activities and goals. We can't play catch unless we're both aware of the other's attention to the ball; working together to move a large piano through a small door-way requires that we are jointly attending to the piano, dimensions of the door, and each other's movements.

But what makes joint attention such a 'hot topic' for me, is how it is beginning to inform our understanding of pedagogical practices. If I show you how to open a tin of beans, I know that in order for this teaching episode to be successful we both have to be attending to the tin, my movements and the tin opener. One cannot teach or learn without the initial capacity for joint attention (Csibra & Gergely 2009). But, whilst there are some kinds of teaching in the animal kingdom, such as meerkats disabling scorpions for their young to practice predatory skills, pedagogical practices are significantly more widespread in human cultures. An explanation for this may lie in the limitations in joint attention in non-human animals; although researchers disagree about whether non-human animals can engage in joint attentional practices at all, those who believe that they can acknowledge that they only do so in very specific circumstances. Humans, on the other hand, spontaneously attend to other's actions and attending. One explanation offered for this spontaneous engagement in joint attention comes from the finding that our 'reward-related' neural circuitry becomes active when we successfully initiate joint attentional episode, e.g., when we manage to direct another's gaze to an object (Schilbach et al, 2009). This goes some way to explaining our motivation to initiate joint attention.

During this year's Carnap lectures in Bochum, Tim Crane suggested that one of the distinctive features of human thought is the ability to seek knowledge for its own sake. Further research into the differences in human and non-human motivation to engage in joint attention has the potential to provide an empirical explanation for why this is so. In addition to this, analysis of the difference in joint attentional capacities between human and non-human animals will advance our understanding of the cognitive abilities facilitating pedagogical practices. For these reasons, joint attention is a very hot topic indeed.

JANE SUILIN LAVELLE
Philosophy, University of Edinburgh

§5
EVENTS

SEPTEMBER

HUMANOBS: From Constructionist to Constructivist Methodologies for building Artificial Intelligence, Reykjavik, Iceland, 1–2 September.

BISP: 7th workshop in Bayesian Inference for Stochastic Processes, Getafe, Spain, 1–3 September.

SOCIAL EPISTEMOLOGY: 2nd Berlin Conference on Meta-Epistemology, Technische Universit"at Berlin, 1–3 September.

ECAP: 7th European Conference in Analytic Philosophy, Milan, Italy, 1–6 September.

ARGUMENTATION IN POLITICAL DELIBERATION: Faculdade de Ciências Sociais e Humanas, Universidade Nova de Lisboa, Portugal, 2 September.

INEM: Conference of the International Network for Economic Method, Helsinki, Finland, 2–3 September.

COMPUTER MODELLING AND SIMULATION: Brno, Czech Republic, 5–7 September.

DOMAINS: Swansea University, Wales, UK, 5–7 September.

ECML PKDD: European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases, Athens, Greece, 5–9 September.

VARIETIES OF REPRESENTATION: Kazimierz Dolny, Poland, 5–9 September.

WPMSIIP: Workshop on Principles and Methods of Statistical Inference, University of Ljubljana, Slovenia, 5–10 September.

PERCEPTUAL MEMORY AND PERCEPTUAL IMAGINATION: University of Glasgow, 6–9 September.

SOPHIA: 2nd Salzburg Conference for Young Analytic Philosophy, Salzburg, Austria, 8–10 September.

PROGIC

The fifth workshop on Combining Probability and Logic, Columbia University, New York, 10–11 September

CSL: 20th Annual Conference of the European Association for Computer Science Logic, Bergen, Norway, 12–15 September.

CP: 17th International Conference on Principles and Practice of Constraint Programming, Perugia, Italy, 12–16 September.

EANN/AIAI: Engineering Applications of Neural Networks and Artificial Intelligence Applications and Innovations, Corfu, Greece, 15–18 September.

THE EXPERIMENTAL SIDE OF MODELING: San Francisco State University, 16–17 September.

PLM: Philosophy of Language and Mind, Stockholm University, 16–18 September.

EXPERIMENTAL PHILOSOPHY GROUP UK: University of Sheffield, 17–18 September.

ICSC: International Conference on Semantic Computing, Palo Alto, California, United States, 18–21 September.

AXIOMATIC THEORIES OF TRUTH: New College, University of Oxford, UK, 19–20 September.

CAEITS

Causality and Explanation in the Sciences, Faculty of Arts and Philosophy, Ghent University, 19–21 September

FEDCSIS: Federated Conference on Computer Science and Information Systems, Szczecin, Poland, 19–21 September.

STATISTICAL COMPUTATIONAL & COMPLEX SYSTEMS: University of Padua, 19–21 September.

UNDERSTANDING OTHER MINDS. EMBODIED INTERACTION AND HIGHER-ORDER REASONING: Bochum, Germany, 20–21 September.

COMPUTER SIMULATIONS AND THE CHANGING FACE OF SCIENTIFIC EXPERIMENTATION: Stuttgart, Germany, 21–23 September.

SOCIAL ONTOLOGY: METAPHYSICAL AND EMPIRICAL PERSPECTIVES: Workshop of the European Network on Social Ontology (ENSO), Luiss Guido Carli, University, Rome, Italy, 21–23 September.

AIM AND NORMS: BELIEF: University of Southampton, 23 September.

KANT AND THE EXACT SCIENCES: University of Notre Dame, 23–24 September.

MEANING IN CONTEXT: Logic and Cognitive Science Initiative (LACSI), North Carolina State University, 23–24 September.

AS: Applied Statistics, Ribno (Bled), Slovenia, 25–28 September.

MRC: 7th International Workshop on Modelling and Reasoning in Context, Karlsruhe, Germany, 26–27 September.

SYNASC: 13th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing, Timisoara, Timis, Romania, 26–29 September.

LANGUAGE, LOGIC AND COMPUTATION: Kutaisi, Georgia, 26–30 September.

Semantics & Philosophy in Europe: Ruhr University Bochum, Germany, 26 September–1 October.
Copenhagen Lund Workshop in Social Epistemology: University of Copenhagen, Denmark, 27 September.
RP: 5th Reachability Problems Workshop, Genova, Italy, 28–30 September.
Formal Epistemology Meets Experimental Philosophy: Tilburg Center for Logic and Philosophy of Science, 29–30 September.
The Semantics and Epistemology of Mental State Ascriptions: Ruhr-University Bochum, 30 September–1 October.

October

PT-AI: Philosophy and Theory of Artificial Intelligence, Thessaloniki, Anatolia College/ACT, 3–4 October.
DKB: Dynamics of Knowledge and Belief, Workshop at KI-2011, Berlin, Germany, 4–7 October.
NIT: Natural Information Technologies, Madrid, Spain, 4–7 October.
ALT: 22nd International Conference on Algorithmic Learning Theory, Aalto University, Espoo, Helsinki, Finland, 5–7 October.
DS: 14th International Conference on Discovery Science, Aalto University, Espoo, Finland, 5–7 October.
EPSA: 3rd Conference of the European Philosophy of Science Association, Athens, Greece, 5–8 October.
European Workshop on Experimental Philosophy: Eindhoven University of Technology, The Netherlands, 7 October.
EPIA: 15th Portuguese Conference in Artificial Intelligence, Lisbon, 10–13 October.
The Nature of Social Reality: University of Calabria, Arcavacata di Rende, Italy, 13–14 October.
TPrag: Theoretical Pragmatics, Berlin, Germany, 13–15 October.
Case Studies in Bayesian Statistics and Machine Learning: Carnegie Mellon University, Pittsburgh, PA, 14–15 October.
Alvin Goldman and Social Epistemology: Saint Louis University Philosophy Graduate Student Conference, 20–21 October.
CSIS: International Conference on Computer Science and Intelligent Systems, Coimbatore, Tamilnadu, India, 21–22 October.
PSX: 2nd International Workshop on the Philosophy of Scientific Experimentation, University of Konstanz, 21–22 October.
URSW: 7th International Workshop on Uncertainty Reasoning for the Semantic Web, Bonn, Germany, 23–27 October.
ADT: Algorithmic Decision Theory, DIMACS, Rutgers University, 26–28 October.
QPL: Quantum Physics and Logic, Nijmegen, 27–29 October.
Epistemic Feelings and Metacognition: Ruhr-Universität Bochum, 28–29 October.
IUKM: International Symposium on Integrated Uncertainty in Knowledge Modelling and Decision Making, College of Computer Science and Technology, Zhejiang University, Hangzhou, China, 28–30 October.
The Epistemology of Logic: Arché Research Centre, St Andrews, 29–30 October.
IDA: 10th International Symposium on Intelligent Data Analysis, Porto, Portugal, 29–31 October.
SASA: South African Statistical Association Pretoria, South Africa, 31 October–4 November.

November

Philosophy of Medicine Roundtable: University of the Basque Country, Donostia-San Sebastian, Spain, 2–3 November.
Latin Meeting in Analytic Philosophy: Universidade de Lisboa, 2–4 November.
The Plurality of Numerical Methods in Computer Simulations and Their Philosophical Analysis: IHPST, University of Paris 1, 3–5 November.
CAS: Complex Adaptive Systems: Energy, Information, and Intelligence, Arlington, VA, 4–6 November.
Semantic Content: University of Barcelona, 4–6 November.
Biologically Inspired Cognitive Architectures: Arlington, Virginia, 5–6 November.
ICTAI: 23rd IEEE International Conference Tools with Artificial Intelligence, Boca Raton, Florida, USA, 7–9 November.
History and Philosophy of Computing: Celebrating the 75th anniversary of the famous 1936 Papers by A. Church, E.L. Post and A.M. Turing, Ghent University, Belgium, 7–10 November.
Ideas of Objectivity: Tübingen, 7–11 November.
SPR: ILCLI International Workshop on Semantics, Pragmatics, and Rhetoric, Donostia, 9–11 November.
M4M: 7th Methods for Modalities workshop, Osuna, Spain, 10–12 November.
Evolution and Norms: Concepts, Models, Challenges: Bucharest, Romania, 11–12 November.
ACML: 3rd Asian Conference on Machine Learning, Taoyuan, Taiwan, 13–15 November.
Risk and Reliability Modelling of Energy Systems: Senate Suite, Durham Castle, 24 November.
ATAI: 2nd Annual International Conference on Advances Topics in Artificial Intelligence, Singapore, 24–25 November.
ICIIC: International Conference on Information and Intelligent Computing, Hong Kong, China, 25–27 November.
ICNI: International Conference on Networks and Information, Chengdu, China, 25–27 November.

MICAI: 10th Mexican International Conference on Artificial Intelligence, Puebla, Mexico, 26 November–4 December.

Wellington Workshop in Probability Theory and Mathematical Statistics: Victoria University, Wellington, 28–30 November.

ICDeM: 1st International Conference on Decision Modeling, Kedah, Malaysia, 29 November–1 December.

Solomonoff Memorial Conference: Melbourne, Australia, 30 November–2 December.

December

CT&IT: International Workshop on Computation Theory and Information Technology, Macau, China, 1–2 December.

LENLS: Logic and Engineering of Natural Language Semantics, Takamatsu-shi, Kagawa-ken, Japan, 1–2 December.

Natural Roots of Human Cognition and Communication: Sensory-motor Concepts in Language and Science: University of Düsseldorf, Germany, 1–3 December.

ICCCI: International Conference on Computer and Computational Intelligence, Bangkok, Thailand, 2–4 December.

Indefinite Extensibility and Logical Paradoxes: Arché Research Centre, St Andrews, 2–4 December.

MindGrad: University of Warwick, UK, 3–4 December.

PT-AI: Philosophy and Theory of Artificial Intelligence, Thessaloniki, Anatolia College/ACT, 3–4 October.

NCMPL: International Conference on Non-classical Modal and Predicate Logics, Guangzhou (Canton), China, 5-9 December.

ACAL: 5th Australian Conference on Artificial Life, Perth, Murdoch, Australia, 6–8 December.

ICIRA: 4th International Conference on Intelligent Robotics and Applications, Aachen, Germany, 6–9 December.

MIWAI: 5th Multi-Disciplinary International Workshop on Artificial Intelligence, Hyderabad, Andhra Pradesh, India, 7–9 December.

The Collective Dimension of Science: Nancy, France, 8–10 December.

Copenhagen Lund Workshop in Social Epistemology: University of Lund, Sweden, 9 December.

ICACM: 1st International Conference on Advanced Computing Methodologies, Hyderabad, Andhra Pradesh, India, 9–10 December.

ICDM: 11th IEEE International Conference on Data Mining, Vancouver, Canada, 11–14 December.

IICAI: 5th Indian International Conference on Artificial Intelligence, Tumkur (near Bangalore), India, 14 December.

NIPS: 25th Annual Conference on Neural Information Processing Systems, Granada, Spain, 13–15 December.

AAL: Australasian Association of Logic, Wellington, New Zealand, 14–15 December.

Statistics and Scientific Method I: The Controversy About Hypothesis Testing: Universidad Nacional de Educación a Distancia (UNED), Madrid, 15–16 December.

ALC: Asian Logic Colloquium, Wellington, New Zealand, 15–20 December.

Internalism versus Externalism: Institute for Logic, Language and Computation, Department of Philosophy, Universiteit van Amsterdam, 16–17 December.

ICISME: International Conference on Information Management and Systems Engineering, Nanjing, China, 16–18 December.

Computing & Statistics: Senate House, University of London, UK, 17–19 December.

Amsterdam Colloquium: ILLC, Department of Philosophy, University of Amsterdam, 19–21 December.

§6
Courses and Programmes

Courses

MLSS France: Machine Learning Summer School, Bordeaux, France, 4–17 September.

Relying on Others. New Perspectives in Social Epistemology: University of Cologne, 7–10 September.

Concepts and Methods in Causal Inference: Torino, Italy, 19–21 September.

Operationalisation of Mental States: Tübingen, Germany, 26–29 September.

Embodied and Embedded Approaches to the Self in Psychiatry and Psychosomatic Medicine: University of Heidelberg, 24–28 October.

FSFLA: International Fall School in Formal Languages and Applications, Tarragona, Spain, 31 October–4 November.

SPR: ILCLI International Workshop on Semantics,Pragmatics, and Rhetoric, Institute for Logic, Cognition, Language, and Information, University of the Basque Country at Donostia, 9–11 November.

LI: Logic and Interactions, Winter School and Workshops, CIRM, Luminy, Marseille, France, 30 January–2 March.

Programmes

APhil: MA/PhD in Analytic Philosophy, 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.
LoPhiSC: Master in Logic, Philosophy of Science & Epistemology, Pantheon-Sorbonne University (Paris 1) and Paris-Sorbonne University (Paris 4).
Master Programme: Philosophy and Economics, Institute of Philosophy, University of Bayreuth.
Master Programme: Philosophy of Science, Technology and Society, Enschede, the Netherlands.
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 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 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 Sebastian.
MRes in Methods and Practices of Philosophical Research: Northern Institute of Philosophy, University of Aberdeen.
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.

MA in Reasoning

An interdisciplinary programme at the University of Kent, Canterbury, UK.
Core modules provided by Philosophy and further modules from Psychology, Computing, Statistics, Social Policy, Law, Biosciences and History.

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 Mathematical Logic and the Theory of Computation: Mathematics, University of Manchester.
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 Sebastian).
Open Mind: International School of Advanced Studies in Cognitive Sciences, University of Bucharest.
PhD School: in Statistics, Padua University.

§7
Jobs and Studentships

Jobs

Post-doc positions: in Robot Learning and Reinforcement Learning, Intelligent Autonomous Systems Group, Darmstadt University of Technology / Technische Universitaet Darmstadt, Germany, to be filled asap.
Post-doc position: in the area of developmental robotics and robot learning, INRIA, Bordeaux, until filled.
Two Post-doc positions: in Machine Learning, in the project "Composing Learning for Artificial Cognitive Systems", INRIA Lille, until filled.
Post-doc position: in Machine Learning, University of California, Irvine, until filled.
Two Post-doc positions: The Quantum Group, Department of Computer Science, University of Oxford, deadline 1 September.
Junior Professor: in Theoretical Philosophy, AOS: metaphysics, philosophy of language, philosophy of mind or epistemology, Department of Philosophy, University of Stuttgart, deadline 9 September.
Faculty Position: in Computational Linguistics, Department of Computer Science, University College London, deadline 30 September.
Full-time tenured academic position: dedicated to teaching and research in analytic philosophy, Institute of Philosophy, K. U. Leuven, deadline 30 September.
Visiting International Fellowship: in Social Research Methods, Department of Sociology, University of Surrey, Guildford, UK, deadline 30 September.
Chair: in Theoretical Philosophy, Department of Philosophy, Uppsala University, deadline 3 October.
Lecturer/Senior Lecturer: in Statistics, Department of Mathematics and Statistics, University of Otago, deadline 5 October.
Invited Professor: for a one to three month visit, in the field of Probabilistic Graphical Models, Knowledge and

Decision team (KOD) of the Nantes Atlantique Computer Science Lab (LINA), deadline 1 November.
PROFESSOR: in Philosophy of Science, AOS: Philosophy of biology and environmental sciences, Université du Québec à Montréal, Montreal, Canada, deadline 14 November.
EIGHT 3-YEAR RESEARCH FELLOWSHIPS: within the project "The Turing Centenary Research Project: Mind, Mechanism and Mathematics", John Templeton Foundation, deadline 16 December.
FULL PROFESSOR: in High-Dimensional Data Analysis, Department of Statistics, University of South Carolina, deadline 31 December.

Studentships

PHD POSITIONS: in Robot Learning and Reinforcement Learning, Intelligent Autonomous Systems Group, Darmstadt University of Technology / Technische Universitaet Darmstadt, Germany, to be filled asap.
THREE DOCTORAL TRAINING GRANTS: School of Computing, Faculty of Engineering, University of Leeds, until filled.
ONE DOCTORAL RESEARCHER POSITION AND ONE STUDENT RESEARCH ASSISTANT: to work in the intersection of philosophy, psychology and cognitive science, Munich Center for Mathematical Philosophy, LMU Munich, until filled.
PHD POSITION: in the area of developmental robotics and robot learning, INRIA, Bordeaux, until filled.
PHD STUDENTSHIP: In Functional Programming, School of Computer Science, University of Nottingham, until filled.
PHD STUDENTSHIP: "Preference Elicitation, Modelling and Analysis under Evidential Reasoning Paradigm for New Product Development", Manchester Business School, University of Manchester, deadline 1 September.
PHD POSITION: in multi-objective reinforcement learning, Informatics Institute, University of Amsterdam, deadline 30 September.
TWO FULLY FUNDED FOUR-YEAR PHD POSITIONS: one PhD student in Natural Logic and Linguistic Semantics and one PhD student in Computational Logic and Natural Reasoning, Tilburg Center for Logic and Philosophy of Science (TiLPS), deadline 15 October.
ALAN MUSGRAVE MASTER'S SCHOLARSHIP: in Philosophy, University of Otago, New Zealand, deadline 1 November.