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**MODEL-BASED REASONING,
ABDUCTIVE COGNITION,
CREATIVITY**

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Abduction - Analogy/Narratology - Discovery

Akinori Abe

How do we discover something? We will not search anything at random. There is a concept of serendipity. Many things have been discovered as serendipity. For instance, penicillin etc. They are perhaps an "accidental" discovery. However not all discovery is not such a luck case. Usually we must prepare before discoveries. We must see the future. I will discuss a human discovery from the viewpoint of abduction. The abduction will be powered by analogy and narratology. I will use examples of the previous works, for instance, art appreciation.

Explanatory Frameworks in Complex Change and Resilience System Modelling

Mark Addis and Claudia Eckert

Conventional modelling and simulation have made huge progress in optimising flows for particular conditions. However heterogenous flows across system boundaries continue to pose significant problems for efficient resource allocation especially with respect to long term strategic planning and immediate problems about allocation to address particular resource shortages. Hospital systems which have various patient, staff and equipment flows are an important type of heterogenous flows. The approach taken here to modelling such flows is an engineering change prediction one (Clarkson et al. 2004 and Eckert et al. (2004). This enables margin modelling by producing system models in dependency matrices with different linkage types.

Change prediction approaches from engineering design can analyse where these bottlenecks in integrated systems would be so that re-resources can be deployed flexibility to avoid them and address them when they occur. Current state of the art of margin research can be furthered by identifying margins on multiple levels of system composition. It can usefully be complemented by a category theory based approach which allows representation of variable and constant proper-ties of models under changing conditions, and the identification of flows within models (Breiner et al. 2020 and Foley et al. 2021). There is a difference between an explanatory framework for a model and how algorithms within the model work. Category theory is useful for formalising such explanatory frameworks as it can both structure systems and permit analysis of their applications in a complementary way.

Automated Diagnostic Reasoning: A Tribute to Lorenzo

Atocha Aliseda Llera

In this talk I shall analyze some questions the automated diagnostic reasoning task poses, under my own Pragmatist view of clinical reasoning and in connection to Magnani's eco-cognitive model of abduction.

The questions to be addressed are as follows: is clinical reasoning an — only — human affair? What are the challenges of automated clinical reasoning? What is the place, if any, of a robotic clinician?

Complementing the Normative Approach of Robot Ethical Standards: A Methodological Account

Francesco Amigoni and Viola Schiaffonati

Standards are increasingly adopted in the field of robotics and autonomous systems, moving from the definition of norms to address safety and interoperability to the attempt to prescribe the behavior of artificial agents according to ethical principles. In this paper, we argue that the current normative approach to robot ethical standards is not enough and a methodological account is needed to fully develop and apply them in practice. In particular, we discuss some aspects that experiments devoted to assessing the compliance of robots to ethical standards should consider.

Rethinking the Embodied Nature of Thought Experiments

Selene Arfini

What happens when we read or hear a thought experiment? In which way is it like walking in another person's shoes? Even if the debate around the exact nature of thought experiments is

still open, it is beyond doubt that they allow us to imagine being in a peculiar situation, a vantage point where we can experience another's perspective as if it was our own. This perceptual change has been differently connected to the fruitfulness of thought experiments as creative tools, pumps for intuition and insight. However, this description has also been so far accompanied by an internalist perspective on how thought experiments work: the creative nature of this tool is traditionally connected to the fact that they are played out only "in our head" and so connected to an equally internalist view of creativity. In this paper, I will argue that an embodied cognition perspective would provide a new understanding regarding the use of thought experiments in proposing creative solutions and ideas. Using different already established theories regarding the embodied nature of language and higher cognitive functions (such as the cognitive metaphor theory), I will discuss how thought experiments are designed to elicit specific bodily reactions, emotions, and feelings. I will so defend the idea that, by creating an embodied change in perspective, thought experiments design the perfect situation in which people can feel, judge, and manipulate a creative idea as it was their own.

Abduction and Analogies in Linguistic Reconstruction Inferences

Cristina Barés Gómez, Ángel Nepomuceno, and Francisco J. Salguero Lamillar

The object of this work is to analyze the kind of inference that we use to reconstruct Proto-languages. The importance of the hypothesis to the process and the whole structure of the reasoning makes us think that we are in front of a reasoning called abduction. We analyze this concrete abductive reasoning, and we specify its nuances and particularities. In fact, what is new in this work is that we center our point on the importance of context and pay attention to a form of abduction that goes beyond the context in which the scientific work is being developed by using contexts from other sciences. Therefore, an inter-contextual chain of inference can be part of abductive processes and the resulting hypothesis is still provisional. To explain the ways of reconstructing proto-languages, where several disciplines play a cognitive role, such as archaeology, history, and linguistics, we need more than one context. We use the case of the reconstruction of Proto-Semitic with the unexpected fact of the Ugarit and Ebla discoveries (plus Amorite names). This sample may shed light on the use of abduction to explain certain scientific practices.

Abduction in Medical Research: The Case of Variolae Vaccinae

Cristina Barés Gómez and Matthieu Fontaine

In this paper, we analyse the case of the vaccination (*variola vaccinae*) against smallpox in Jenner's work (1909-14). Jenner's research begins with a first hypothesis: the cowpox is an illness that can also affect humans and then makes them immune to the smallpox. This hypothesis constitutes the basis for the physician's action. But it is only when patients will have been exposed to the virus, and recovered, with sufficient regularity, that the initial hypotheses will be (defeasibly) confirmed. Hypotheses, planning of trials and confrontation with facts can be connected within the Gabbay and Woods model (2005), in which abduction is considered as an ignorance-preserving inference.

First, we begin with an account of medical reasoning within the GW model of abduction, and its application to the case of vaccination in Jenner's research. Then, we apply the Select and Test model medical reasoning advocated by Magnani (1992) to this case study, and consequences are drawn with respect to the use of hypotheses in medical reasoning. This leads to take part in an actual debate in the philosophy of medicine between "mechanistic" and "probabilistic" perspectives. Following theses advocated by Russo and Williamson (2007), it is acknowledged that both perspectives are necessary to establish causality in medicine. Our proposal is that these perspectives would be better understood in inferential terms: whereas mechanisms result from abduction, probabilities and statistics result from empirical trials and induction.

Occurrence-Referential Languages

Francesco Bellucci

In this paper I offer a theoretical distinction between two families of logical languages, which I call "occurrence-referential" and "type-referential" languages. A type-referential language is a language in which sameness of variable type determines sameness of reference, while

distinctness of variable type may (though it need not) determine distinctness of reference. An occurrence-referential language is a language in which sameness of variable occurrence determines sameness of reference, while distinctness of variable occurrence may (though it need not) determine distinctness of reference. This distinction may apply to the representation of individuals (“quantificational level”) or to the representation of predicates (in predicate logic) and sentences (in sentential logic) (“predicate level”). The distinction is first and foremost extracted from an analysis of expressively equivalent logical languages, i.e. languages that represent the same logic. I also consider two basic modalities of notational variance: typographical variance (difference in the symbols used in a language for some or all the logical constants) and vocabular variance (difference in the set of primitives), and I show that the distinction between type- and occurrence-referential languages is not reducible to either typographical or vocabular variance.

Neuroscientific Model-Based Computation and Philosophical Model-Based Reasoning – A Window for an Interdisciplinary Collaboration

Olgierd Borowiecki

The term “model-based” is operationalized in both neuroscientific and philosophical research. This work analyses the former conceptualization and concludes that the philosophical understanding is compatible with neuroscientific one. Furthermore, philosophical insight about the model-based reasoning contributes to design of experimental protocols in neuroscience and psychology, which is discussed in this work.

In particular, philosophical inquiry is particularly relevant for designing psychological and neuroscientific experiments. In psychology, brain imaging techniques are used for pinpointing neural structures involved in belief acquisition (Babayán et al., 2018; Nour et al., 2018) albeit without specifying what beliefs are being acquired. In neuroscience, advanced optogenetic techniques are used for labelling particular neurons as “memory engrams” mediating a given (usually fear) memory (Kitamura et al., 2017; Wagatsuma et al., 2018). These experimental protocols can be redesigned with philosophical insights about the actual kind of reasoning done by with the model-based computations. For example, philosophical analysis of a task structure opens a possibility for precise description of a reasoning that is required for completing the task (for animal model or for human). Such philosophically driven task design combined with neuroscientific/psychological experiments offers a window for grounding particular kinds of reasoning in brain structures and tracing its evolutionary origins. This work requires an interdisciplinary collaboration which could be established during the conference.

Reasoning about Knowledge and Epistemic Equivocity

Yves Bouchard

Knowledge representation is one way to exploit expertise in a given domain by logical means. But, what kind of knowledge does one acquire from an inference (or inference on a query result over a knowledge base)? Such a question may appear awkward since the answer seems so obvious: from an inference, one simply acquires knowledge. This is undoubtedly the case when only one type of knowledge (for instance, expert knowledge) is involved in an inference. What if several types of knowledge are involved? What type of knowledge can one deduce from a plurality of knowledge types? I claim that reasoning with different knowledge concepts requires a fine-grained representation of knowledge in which every knowledge type finds a singular expression in order to avoid some epistemic equivocity associated with a coarse-grained representation of knowledge. In the first part of the paper, I revisit the Muddy Children Puzzle, which usually serves to illustrate common knowledge in dynamic epistemic logic. I try to show that this problem also shows some sort of epistemic equivocity between concepts of knowledge and, consequently, that the problem calls for some epistemological refinements concerning the representation of the types of knowledge at play in an inference. In the second part, I address this issue from a semantic point of view, and I develop a fragment of epistemic logic capable of providing a solution to the problem of epistemic equivocity.

On Computational Models of Interconnected Perception, Reasoning, and Action – in Dream Worlds

Selmer Bringsjord and Paul Bello and Antonio Chella and Naveen Sundar Govindarajulu

We distinguish between real versus unreal worlds, and include in the latter category fictional worlds and – perhaps the hardest type of unreal world to plumb – dream worlds. Dream worlds, from the standpoint of building computational cognitive models, present a number of acute challenges in at least three areas of human mentation that are for us as AI researchers and computational cognitive scientists deeply interconnected; these areas are: perception, reasoning, and action. We are attempting to specifically answer three tough questions, one in each of these three areas; the answers (for us) must be based upon robust computational models that are both theoretically well-founded, and brought to life in implemented simulations. (Such models are to our knowledge in very short supply.) Ultimately, we acknowledge that the research trajectory we summarize herein must arrive at a way to informatively model different modes of consciousness in the human mind, which, remarkably, is capable of sustaining utterly coherent consciousness across waking, imagining, and dreaming.

Abduction vs. Concept Refinement and Structural Preservation: Perspectives on Mathematical Heuristics

Otávio Bueno

Lorenzo Magnani [2001] has developed a rich framework to characterize abduction, its different kinds, and its role in mathematical discovery, especially in geometry. On his view, which combines Kantian and Peircean elements, abduction is crucial in the process of generation and evaluation of explanatory hypotheses. Some abductive inferences are based on models (model-based abduction), others involve the integration of new experiences into “previously existing systems of experimental and linguistic (theoretical) practices” (manipulative abduction; Magnani [2001], p. 160). In this paper, I contrast abduction with a different approach to mathematical heuristics: a thoroughly deductivist and empiricist stance that emphasizes the role of concept refinement (Lakatos [1976]) and structural preservation (da Costa and French [2003], Bueno [2000], and Bueno and French [2018]) in the formulation of new mathematical conjectures. I argue that the latter has independent plausibility and can overcome some of the former’s shortcomings.

Serendipity and Thought Experiment in Scientific Discovery

Marco Buzzoni

Method and creativity seem, at least at first glance, to be opposing concepts and give rise to what, in the discussion around the concept of serendipity - i.e. the phenomenon whereby a fortuitous and unexpected experience turns out to be an essential element leading to a discovery or invention - has been considered paradoxical and oxymoronic: Serendipity invokes chance and luck and at the same time presents itself as a kind of method, capable of leading to ever new discoveries or inventions. The solution I propose is based, on the one hand, on the rejection of the neo-Positivist (and Popperian) distinction between discovery and justification and, on the other, on the concepts of thought experiments that I have developed elsewhere. On the one hand, it is necessary to question both the neopositivist distinction between discovery and justification and its later and more recent rejection within the epistemological tradition. To this end, it is necessary to distinguish two different but complementary ways - one reflexive, the other genetic-methodological - of interpreting the discovery/justification dichotomy. This distinction makes it possible to resolve the paradoxical character of the concept of serendipity, understanding in what precise sense both the initial lucky chance and the unpredictable human discovery are entirely reconcilable with the principle of intersubjective testability of any scientific discovery worthy of the name. While the element of lucky chance and unpredictability of human discovery is to be explained on the basis of the typical capacity of human reason to formulate counterfactual scenarios or, in a very general sense, thought experiments, the consistent rejection of the dichotomy discovery/justification in a genetic-methodological sense explains why contingent and unpredictable events can be, so to speak, “redeemed” by making them an initial moment from which a series of steps follow that lead, in an intersubjectively reconstructible manner, to the discovery itself. It follows that the most widespread definition

of serendipity as the sum, combination or juxtaposition of planned insights and unplanned events is not sufficient. The ingredients are right, but how they are to be fused together is still missing. Instead, we should say that serendipity arises from accidental (and therefore unplanned) events that become part of a ‘planned’ and in the first person reconstructible and intersubjectively testable insight.

Overcoming Self-Reference Modelling

Paola Cattabriga

At the heart of the cognitive science we have a very ancient plan to mechanize the whole human knowledge together with the needs of the scientific discovery to expand the logical reasoning. The emerging of antinomies and arguments like incompleteness and undecidability led these two cognitive aspirations to diverge. This contribution claims the existence of a unique model of self-reference reasoning posed at the origin of such forking path by Cantor’s diagonalization, and the subsequent Gödel’s incompleteness and Turing’s undecidability, since all these so-called theorems trace expressive restrictions for the predicate calculus applying some form of diagonalization. Author’s investigation in self-reference procedures provides proofs leading to the overcome of such model, proofs based on the definition of the complement of the set or predicate which is on a case by case subjected to diagonalization. As already showed, this offers an explicative guide about that the so-called Cantor’s theorem is not actually acceptable in a first order set theory, and similarly for Gödel’s incompleteness in Peano Arithmetics and Turing’s undecidability for the first order calculus. This article highlights their connections, and offers an explanation on the basis of the criteria of the Theory of Definition. The overcome of this self-reference model aims to reintegrate the expressive power of predicate calculus, and thus to some rejoin or mutual exchange of the two different cognitive pathways.

The Paul Effect: The Persuasive Allure of the Unbeliever’s Enlightenment

Gustavo Cevolani, Vincenzo Crupi, Marco Viola

We introduce the Paul Effect, a pattern of persuasive storytelling operating across several epistemic domains and provide a rational reconstruction of its workings within a Bayesian framework.

The pattern is named after two case studies where it seems to obtain: the conversion of Saul from Tarsus into Paul the Apostle due to his enlightenment on the road to Damascus and the conversion of the psychologist Paul Ekman from cultural relativism toward innatism with respect of the facial expression of emotions.

We suggest that, for those who are in no position to directly assess the epistemic import of some event, a narrative involving a conversion from disbelieving to believing something after exposure to the very event may be taken as a proxy of the evidential strength of the event – provided that the conversion is felt as genuine.

But why? Intuitively, compared to an agent with stable beliefs, an agent whose opinion has been reported to shift may be perceived as more likely to have considered (stronger) evidence. Offering a rational reconstruction of the Paul effect on the background of Bayesian philosophy of science affords further potential insight.

According to Bayes’ theorem, $P(h|e)$ is an increasing function of $P(e|h)$ and $P(h)$, and a decreasing function of $P(e|\neg h)$. In our reconstruction, the Paul effect works because it allows to counter three confounds that are known to possibly lead to overestimating $P(h|e)$: wishful thinking (leading to overestimate $P(h)$), ad hoc accommodations of e (leading to overestimate $P(e|h)$), and overlooking alternative explanations of e (leading to underestimate $P(e|\neg h)$). As we show, when an agent declares that they deem $P(h|e)$ high, adding that before considering e they believed in h^* , which is inconsistent with h , one has good reason to think that none of these three confound played a role, and hence that $P(h|e)$ was not overestimated after all. In turn, this justifies the pattern of reasoning identified here and explain its persuasiveness.

Hypothetical Reasoning in Textual Criticism: Patterns of Abductive and Bayesian Inference

Gustavo Cevolani and Silvia Di Vincenzo

Textual criticism aims at establishing the most accurate and reliable version of texts that have been transmitted to us through copies whose complete adherence to the original is a matter of doubt. Its primary method provides a paradigmatic example of a scientific approach in the humanities. Still, no logical or epistemological analysis of such a method is presently available. This paper aims to fill this gap, providing a philosophy of science outlook of textual criticism and a logico-probabilistic analysis of its methodological principles.

Our case study is a fundamental criterion known as the principle of *lectio difficilior potior* (“the harder reading is superior”, LD henceforth). LD allows choosing, among different variant readings (“lessons”) of the same portion of a text transmitted by its different copies, the one that is more likely to be original. In short, when one of the different lessons is more “difficult”, i.e., less usual or more sophisticated, than the other(s), LD suggests preferring the former to the latter, because, in the process of copying a given text, it is easier to accidentally simplify (thus turning a *lectio difficilior* into a *facilior*), than to introduce more complex lessons (turning a *lectio facilior* into a *difficilior*).

In this paper, we suggest two different interpretations of LD, as a pattern of, respectively, Bayesian and abductive inference. We explore in detail the principles guiding the logic of LD, propose a probabilistic reconstruction, and assess both interpretations based on it. Our results both provide an epistemological justification of LD as a sound principle of scientific inference and clarify its general applicability conditions. All in all, the paper provides (to our knowledge) the first analysis of a central principle of textual criticism, paving the way for the study of other methodological principles both in this field and in other historical disciplines.

Two Types of Hypothesis and Denial. A Logical Analysis

Daniele Chiffi and Ciro de Florio

In this talk we will investigate the concept of hypothesis and the (illocutionary) act of hypothesizing within a new logical framework inspired by the pragmatic logic PL. PL can be used in order to develop various systems in which the logical features of illocutionary acts such as asserting, denying, conjecturing, hypothesizing and so on can be characterized. We will provide a novel (twofold) logical framework capable of characterizing two types of hypothesis, that is, weak and strong types of hypothesis. Finally, we will show the logical relations between these two types of hypothesis and the act of denial (or rejection) in order to explicate in a better way the dynamics of scientific hypotheses.

Trustworthy AI: A Pragmatic Stance

Daniele Chiffi, Mattia Petrolo, Viola Schiaffonati, Giacomo Zanotti

The current debate on the notion of Trustworthy AI (TAI) largely boils down to the contraposition between two alternatives, neither of them completely satisfying. Opting for a cognitive account of trust, that takes trust to be a matter of purely rational choice and probability estimation, allows us to make sense of the notion of TAI but fails to differentiate TAI from merely reliable AI — a distinction that is usually deemed essential. Motivational accounts of trust, instead, focus on the motivations and moral obligations of the trustee and clearly distinguish trustworthiness from reliability. However, provided that AI systems hardly possess motivations and moral obligations, the notion of TAI turns out to be a categorical error. In both cases, the notion of TAI somehow reduces to the one of reliable AI. We contend that this outcome is undesirable. AI systems are not ethically neutral, and the notion of TAI allows us to go beyond mere reliability and consider critical ethical dimensions involved in the design and use of AI systems.

We provide an alternative framework for addressing the question of TAI. In our view, the current philosophical debate builds upon two wrong assumptions, namely that (i) trust in AI should be uncompromisingly modeled on interpersonal trust and (ii) the attribution of trustworthiness to AI systems should be understood literally. We argue in favour of a more pragmatic stance that takes talk of trustworthy AI to be an instance of useful loose talk, that maintains the focus on the ethical dimensions of trust without literally ascribing interpersonal

trustworthiness to AI systems. We conclude by extending our pragmatic approach to the question of the determinants of trust in AI, insisting on the role played by contextual factors.

Brain Organoids as Models: Ethical and Epistemological Issues

Alice Andrea Chinaia

Human brain organoids are in vitro three-dimensional models of the human brain generated from human stem cells. They have raised several ethically-relevant questions, including those on sentience (Lavazza, 2021), moral status (Barnhart & Dierickx, 2022), and following protection in research (Koplin & Savulescu, 2019), ownership (Mollaki, 2021), and informed consent (Bollinger et al., 2021), among others.

The ethical discussion, however, has developed independently from any epistemological or methodological reflection on organoids as models of the human brain. This is not surprising, given that ethics and epistemology have long been kept separate due to the different kinds of questions they raise and the methodology they use. Recently, however, some authors have argued that advancements in the field of biotechnology, such as chimerism and gene editing, call for an integrated approach between these two branches of the philosophical discussion (Lohse et al., 2020).

In this paper, I propose a tentative analysis of brain organoids that may start filling the gap between the ethical and the epistemological discussion of their nature and use. I proceed as follows.

Firstly, the ethical issues that might benefit the most from the contributions of an epistemological analysis will be briefly presented. The issues of sentience, public engagement, informed consent, and the use of brain organoids instead of - or in combination with - animal models will be briefly overviewed. Second, I will focus on how the epistemological analysis could help guide the neuroethical discussion. Since no analysis of organoids as models is presently available, I hypothesize that brain organoids' role in biomedical science is similar to that of animal models and I will consider the distinction LaFollette and Shanks (1995) make between hypothetical (HAMs) and causal analogical models (CAMs). To see whether their framework also fits brain organoid research, I propose a case-study overview of the literature, providing evidence that scientists use brain organoids both to formulate novel hypotheses on the functioning of the human brain and to test them.

Understanding the nature and role of brain organoids as models is crucial to understand what kinds of inferences are licensed by such models and if they are valid. In turn, this can have important implications for the ethical discussion at the foundational and application levels. Given the fast pace of research, the ethical discourse would only benefit from this kind of multidisciplinary integration and dialogue with other fields, including, but not limited to, philosophy of science.

The Doing/Allowing Distinction: Moral Heuristics and Causal Models

Camilla Francesca Colombo

Is doing harm morally worse than allowing it to occur? Our every-day intuitions, supported by a long-standing tradition in moral philosophy, argue that this is the case. After all, drowning a man into a pond and not rescuing a drowning man amount to two different conducts, which we evaluate differently from a moral viewpoint. Nonetheless, more recent studies into cognitive biases, framing effects and moral disagreement have pointed out that, besides clear-cut cases like the pond example, our intuitions over the doing/allowing distinction are far from robust and reliable. In short, a) descriptively equivalent actions can be either characterized as “doings” or as “allowings”, depending on the framing of features which should be morally irrelevant; b) an “allowing” action can be perceived by some people as morally worse than a “doing” action. This line of research casts doubts over the adequacy of our intuitions in grounding the moral principle “doing is worse than allowing”, and seems to downplay the doing/allowing distinction as a cognitive bias or as a byproduct of our flawed reasoning skills. If this were the case, there would be nothing morally relevant about the doing/allowing distinction, and we should acknowledge that our moral intuitions lead us astray.

Ethics as Generative Modelling

Samantha Copeland

This talk takes up the relation between model based thinking and ethics. I begin with a close look at what it would mean to model utopia as ethical practice, and find that this leads to a degenerative ethics. In contrast, I call for a generative approach to modelling, drawing from work by Nersessian, and expanding on Magnani's idea of using model-based thinking to make hidden implications and assumptions explicit, and to elicit new knowledge in ethics. What I propose, however, is something akin to a reversal in direction. Coupled with an experiential and interactive practice, the ethical work to be done, I argue, is not in the creative imagining of a possible world itself, but rather in deciphering the components and constraints of such a model. Turning ourselves around to look into why and how we build our models of a better world, in turn, better integrates surprise, anticipation and insight into ethics practice and teaching in a way that utilizes these features of our experience rather than externalizing them, in a iterative and ongoing process that prioritizes progress over outcomes and collaboration over decision-making.

Inferring to the Best Explanation in Cognitive Neuroscience

Davide Coraci, Igor Douven, and Gustavo Cevolani

Reverse inference (RI) is a reasoning strategy neuroscientists rely on to establish associations between brain activations as observed in functional Magnetic Resonance Imaging (fMRI) experiments and the engagement of cognitive processes that could explain those activations. Recent methodological works discuss RI both as a pattern of probabilistic reasoning and as a form of abductive reasoning or inference to the best explanation (IBE). However, the status of RI is contested and the reliability of neuroscientific explanations based on RI strongly depends on specific factors, such as the methods employed to analyse brain data.

In this paper, we highlight prospects and limits of the analysis of RI in light of recent work on IBE, focusing on some methodological issues highlighted in the debate about neuroscientific explanation. We start by discussing the key differences between the main methods used to perform RI in cognitive neuroscience, such as univariate versus multivariate methods, and Representational Similarity Analysis. Then, we survey recent theoretical and empirical results about IBE, highlighting a number of criteria philosophers have proposed for assessing the quality of competing explanations construed as conclusions of abductive inferences. Finally, we show how such philosophical discussion of IBE can shed light on the methodological debate about RI. To this purpose, we discuss in detail two case studies from the recent neuroscientific literature, which provide especially clear illustrations of how different methods for performing RI can support weaker or stronger conclusions in terms of IBE. We conclude with some general observations about explanation and inference in cognitive neuroscience.

Depth-Bounded Epistemic Logics and Logical Omniscience as a Matter of Degree

Marcello D'Agostino and Costanza Larese

Logical omniscience appears to be an inescapable consequence of defining knowledge through Kripke structures. This assumption requires agents to know all the logical consequences of what they know and, in particular, to know all tautologies. If, as it happens in classical epistemic logic, the consequence relation is based on classical logic, the assumption of logical omniscience becomes problematic in any realistic context. While it might perhaps be attained by idealised reasoners, it cannot be satisfied in practice and is utterly inappropriate for modelling human reasoning. In this talk, we present for the first time Depth-Bounded Epistemic Logics (DBELs), which aims at providing a representation of knowledge held by realistic agents. Our strategy for attacking the problem of logical omniscience is to waive the consequence relation of classical logic in favour of weaker ones. To this end, we chose the consequence relations of Depth-Bounded Boolean Logics (DBBLs) (D'Agostino, 2015; D'Agostino, Finger, and Gabbay, 2013; D'Agostino and Floridi, 2009). Therefore, DBELs are an extension of the propositional semantics of DBBLs to the possible-world semantics, in much the same way as classical epistemic logic is an extension of Boolean logic to the modal language. We argue that, with respect to the consequence relations of DBBLs, it may be safely assumed that knowledge is closed under logical consequence. The philosophical motivations of the

DBELs approach, as well as its fruitfulness for modelling the reasoning held by realistic agents, are examined in depth. The technical details of this family of logics are also provided and explained through a guiding example. Both our strategy to mitigate the problem of logical omniscience and the resulting definition of knowledge held by realistic agents are compared to the most widespread proposals in the literature. Criticism from a depth-bounded perspective of the usual epistemic axioms is also provided.

Causation, Goals, Values, and Models

David Danks

Causal models are often interpreted in a realist manner; that is, they are thought to describe what actually causes what in the world. In this talk, I will argue instead that both variables and connections in causal models necessarily depend on people's goals and values. In particular, causal models should be understood as "useful fictions," and should be judged by their utility in supporting multiple scientific and practical capabilities, rather than any notion of 'truth'. I will argue that this pragmatic stance resolves a number of concerns and confusions about causality, particularly so-called inter-level causation. Throughout the talk, I will draw on examples from neuroscience, cognitive science, and public health.

Models for Surrogate Stimulation

Edoardo Datteri

In some areas of scientific research, concrete models are used to stimulate the system under investigation, and not to represent it. In particular, in these cases, a concrete model M representing a target system T stimulates the system S under examination, in order to evaluate how S would react if the stimulation came from T . Examples of this experimental approach date back to Tinbergen's use of animal decoys to study social releasers, and abound in contemporary interactive biorobotics. This use of models can be called 'surrogate stimulation', since the system under investigation (S) is stimulated by a surrogate (M) of the system (T) that normally interacts with S . Surrogate stimulation has so far been neglected in the philosophical literature on models, although it is increasingly being applied to the study of animal behavior and social cognition. In the talk it will be shown how surrogate stimulation can be distinguished from other forms of (nonsurrogate) stimulation and from interventions as defined by J. Woodward and others. It will also be argued that surrogate stimulation does not involve surrogate reasoning. For this reason, the talk identifies a use of concrete models that is significantly different from the way models are typically used in scientific research.

Constructs as Building Blocks for Psychological Models. When Assessment Misrepresents the Phenomenon It Is Designed to Measure: 'Alexithymia' as a Case Study

Sara Dellantonio and Luigi Pastore

Psychology broadly relies on hypothetical concepts such as empathy, emotion, anxiety, personality, and intelligence that do not denote directly observable phenomena. They are introduced to help make sense of the available behavioural and neurophysiological evidence on our mental life. Conversely, considering how these concepts are designed, defined, and articulated is an essential step in exploring the nature and reliability of psychological models. A number of experimental psychologists share the view that these concepts should be conceived as constructs resulting from operational definitions like those proposed by Bridgman in physics. Since operational definitions can provide increased accuracy and reliability in the definition of concepts, they were often considered indispensable for a psychological science. Yet, a well-known consequence of operational definitions is that the way we define a concept becomes dependent on the way we measure and assess it. E.g., our concept of intelligence depends on the way we assess it; if we developed several tests, we would end up with several (irreducible) concepts of intelligence. Operational definitions are particularly tricky in the soft sciences such as psychology (mainly) because 1. the same construct is typically measured by multiple tools; 2. a number of assessment instruments used in psychology have remarkable intrinsic limitations; this applies especially to self-report questionnaires which are often unavoidable and put the problem of introspection back in the limelight; and 3. more precise and better measurable definitions can lead to misrepresentations of the original

phenomena. Moving on from a general discussion of these aspects, we will focus on a concrete example which shows why operationally defined constructs are problematic, by discussing the history and evolution of the construct of alexithymia (which describes a subjective condition characterized by the incapacity of some people to fully experience their own emotions) and the instruments used to assess it.

The Arguing Through an "Adjunction": Its Relevance for the History of Mathematics, Logic and AI

Antonino Drago

From the notion of "adjunction", scattered in key locations of several scientific and non-scientific texts, I go up, through Lazare Carnot's methodological suggestions, to a method of reasoning that applies all four Charles Peirce's inferential processes to compose a cycle of arguing. It belongs to a kind of theoretical organization which, although in the past was depreciated as a purely intuitive way of theorizing, can be formalized in intuitionist logic, as standing on a same par of the axiomatic organization. Remarkably, it cannot be implemented by a computer and therefore assures the superiority of mankind on automated machines. This result qualifies in logical terms Peirce's philosophical suggestion of the "impotencies" of the "thinking machines".

Climate Science Narratives: Scenarios, Pathways and Storylines. Some Open Questions and a Promising (Thought Experimental) Avenue?

Rawad El Skaf

This paper is programmatic and still at the stage of a work in progress; it aims broadly at analysing the use of narratives in climate science: scenarios, pathways and storylines. One proposed novel avenue would be to investigate the merits of characterizing climate science narratives as collectively conceived thought experiments.

Quantitative approaches are regarded as the benchmark of scientific rigour. Besides their role in scientific research, they have also played a prominent role in decision-making, providing information that enhances control and enables optimisation. Nevertheless, the adequacy of purely quantitative approaches is forcibly questioned in scientific fields that are complex, interdisciplinary, deal representations with "deep" uncertainties of different kinds and are socially relevant. This is most notable in the climate sciences. Indeed, climate scientists have progressively adopted more qualitative approaches, more precisely a hybrid form that includes both quantitative and qualitative elements. Narratives such as scenarios, pathways and storylines have been introduced and developed and are – to a greater or lesser extent – adopted by the Intergovernmental Panel on Climate Change (IPCC) latest report (AR6 2021).

Many recent philosophical analyses into climate science narratives are being recently proposed, most notably by Elizabeth Lloyd, Naomi Oreskes, Eric Winsberg, Wendy Parker and Daniel Steel. However, none has drawn upon the huge philosophical literature on thought experiments (TEs). Seeing that scenarios, pathways and storylines are partly composed of hypothetical narratives describing plausible climate or socioeconomic futures, they curiously resemble TEs. Granted that the philosophical literature on TEs is characterized by a multitude of accounts of what TEs are, how they function, what sorts of epistemic good(s) they provide and how they justify it/them, it is hardly debated that TEs are published and communicated as short, hypothetical (sometimes counterfactual) narratives. One way would be to analyse these climate science narrative as collectively conceived TEs. Treating climate science narratives as collective TEs promises to provide new and interesting avenues to analyse the qualitative approaches in climate science, or at least highlights crucial differences that would, to the contrary, inform us that it would not be particularly enlightening to characterize climate science narratives as TEs. This in turn could provide interesting and novel avenues for philosophers investigating TEs.

Generic Reasoning: A Logical Sketch

Federico L.G. Faroldi

I sketch a theory of generic reasoning which explains how a single significant instance may support general conclusions, with possible exceptions being tolerated. I will argue, as a working hypothesis, that generic reasoning is irreducible to currently recognized kinds of

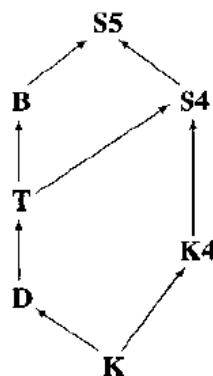
“pure” reasoning. The main idea that I will exploit is to use both the exact verification and falsification conditions of an arbitrary truth-maker (falsemaker) (the single instance) within a hyperintensional account of logical consequence (to establish general conclusions), with two aims in mind. The first aim is to identify the commonalities and differences between practical human reasoning, theoretical human reasoning engaging with external reality, and abstract (possibly human-unrelated) domains, in light of the idea that a single significant instance may support general conclusions. The second aim is to explore genericity from a theoretical point of view, with the aim of precisely capturing generic reasoning in a formal model, in order to be able to apply it to the aforementioned domains. Having such a precise model will open up the possibility of understanding previously unrecognized phenomena generically, and discuss the place of generic reasoning in epistemology and the practice and philosophy of science.

Adaptive Structure Seeking Dialogues (A-SSD)

Matthieu Fontaine

We propose a new dialogical approach called Adaptive Structure Seeking Dialogues (A-SSD). The aim is to give light to the strategies underlying the Structure Seeking Dialogues (SSD) of Rahman and Keiff (2005) in the context of an adaptive modal dialogical logic. The main innovation is that the players of the argumentative game are allowed to conjecture an underlying modal framework by passing from a lower limit dialogical logic to an upper limit dialogical logic, helped by a auxiliary diagrammatic based reasoning.

In dialogical logic, the proponent’s thesis is valid if he is able to defend himself against every possible challenge of the opponent. In the SSD, when the proponent is not able to win,



he is allowed to make conjecture with respect to the underlying modal frame. In terms of adaptive logic, we can say that the proponent asks to pass from a lower limit dialogical logic to an upper limit dialogical logic with a more permissive set of rules. The articulation of the different modal logics in the A-SSD can be explained in terms of an auxiliary diagrammatic based reasoning, following representations such as Fitting and Mendelsohn (1998). Indeed, in adaptive logics, the notions of lower limit and upper limit are relative. For example, the modal logic D (serial) is an upper limit logic of the modal logic K (no condition). But if the proponent cannot win with the rules for D either, then he can ask to play with the rule for T (reflexive), following the left path in the following diagram (in Fitting and Mendelsohn (1998, 20)):

While the modal logic D was an upper limit logic with respect to K, it becomes a lower limit logic with respect to T. Another possibility would have been to choose K4 as an upper limit logic, then S4; and so on.

Computing Abductive Hypotheses in Artificial Neural Networks: A Hybrid Approach

Andrzej Gajda, Julia Flejsierowicz, and Mariusz Urbański

We define an abductive procedure that is capable of generating abductive hypotheses employing Artificial Neural Networks (ANNs). To this end, we designed an integrated hybrid system, in which the initial knowledge base and an abductive goal, represented as logic programs, are translated into an ANN, which is subsequently trained in order to attain the defined abductive goal. The resulting new ANN is then translated back into a logic program.

We construe our hypotheses as symmetric differences between the initial and the resulting knowledge bases. We present the implementation of our procedure for both definite and normal logic programs. We also compare the results of employing the backpropagation learning algorithm and also more efficient strategies for neural network training.

Combinators as Presheaves

Rocco Gangle, Fernando Tohmé, and Gianluca Caterina

Among the Turing complete models of computation, the one based on the the logic of combinators has recently drawn renewed attention from computer scientists, logicians and other researchers. Combinators may be understood not only as elementary structures for generating arbitrarily complex logical and computational operations, but also as theoretical frameworks for modeling representational and reasoning processes in general. Yet despite its generality, elegance and simplicity, the combinator-based model of computation is notorious for the clumsiness and near-unreadability of its standard syntax. We aim to address this drawback of the system by developing a new mathematical formalization of the syntax of combinators employing the “generic figures” approach introduced by Reyes, Reyes and Zolfaghari based on categories of presheaves. The main advantage of this approach is that it supports a visually intuitive and easily interpreted diagrammatic syntax for combinators on the one hand and yet remains in itself a precise and mathematically rigorous formalization on the other. We define a category CB such that each combinatory term is a functor $F : \text{CBop} \rightarrow \text{Set}$ with the morphisms being natural transformations between those functors. This technical machinery provides a precise mathematical framework that represents the intuitive (and diagrammatically picturable) notion of a syntactical combinatory term as a complex arrangement of nested operations. The straightforward use of morphisms in the topos Set^{CBop} allows for the characterization of all essential structural features of combinators and their operational dynamics. Furthermore, we show how additional representational resources in Set^{CBop} provide for the possibility of representing choices of argument from among given alternatives at each level of a combinatory term, allowing for a more general type of combinatory expression which we call a multi-combinator. We conclude by showing how multi-combinators are especially useful for capturing the notion of hypotheses in computational settings.

Ongoing Activity of the Brain: Perception Between Prediction and Errors

Fabrizia Giulia Garavaglia, Simone Pinna, and Marco Giunti

The brain is constantly predicting the future to compare it with the past, using old experiences to anticipate what is supposed to come next. For decades, in a behavioral perspective, it has been believed that the brain processes inputs by reacting to stimuli that comes from the outside world through the sense organs. In the last two decades, however, the brain has been understood in its ongoing predictive and creative activity of generating internal models, rather than in its reactive action. This idea is the foundation of the predictive coding approach. Carey, Tanaka and Van der Meer (2019) maintain that, in the field of computational neuroscience, the opposition between behavioral and computational explanations of the mind comes in the new form of a model-free vs. model-based approach. This article will show how the model-based approach, in the form of predictive coding, overcomes the weaknesses of a purely behavioral approach. However, predictive coding has some problematic points, as well, that we identify in two major issues: (I) how can the brain apply similar mechanisms to handle qualitatively different degrees of prediction (e.g., concurrent imaginative and procedural predictions)? (II) How is it possible to reconcile the presence of stable mental representations with the continuous dynamic change of perceptual data? Therefore, we propose, based on the interpretation of some empirical data from the study of visual perception, the introduction of a hybrid approach, in which some aspects of behavioral explanations are brought back into the realm of model-based explanations.

Complexity, Habits & Society

Raffaella Giovagnoli

The notion of “complexity” is a central topic in the philosophy of science and in sociology, that aims to grasp the relationship between systems and their environment. Complexity indicates

also the possibility to describe unity (system, environment, world etc.) by appealing to the distinction among elements and their relations. This possibility has been used in many different ways and has assumed a wide variety of nuances throughout history. We consider a peculiar aspect in the large debate on complexity, namely a notion of complexity that is constituted by human habitual behavior to shape individual and social daily life. This analysis is far from using functionalism namely the analysis of individual and social systems. Rather, it aims at describing important traits of human selection of relevant information by considering the function of habitual behavior in individual and social contexts.

Expressing Knowledge as Linked Data by FOOL

Marco Giunti and Simone Pinna

The vision underlying the development of the Semantic Web is that the whole complex of our knowledge forms a huge semantic net, which should be represented and made explicit by means of declarative languages such as RDF, RDFS or OWL. However, these languages have important expressive limits, for none of them reaches the full expressive power of a first order language. An unfortunate consequence of this fact is that, at the moment, huge portions of our knowledge—in particular, mathematical and scientific theories—cannot be made available on the Semantic Web as linked data, not even in principle. In this work, we are going to define FOOL (First Order Ontology Language), a new and surprisingly simple ontological language compatible with RDF, which allows for the expression of any formula of a first order language as a connected RDF graph. FOOL is a declarative language as expressive as a first order language but, unlike this kind of language, its statements have not a serialized form. Instead, like a RDF statement, each statement of a FOOL knowledge base is a connected graph, and different statements link to each other through the nodes they share. The linking nodes are either concepts (i.e., relations or functions), individuals, or logical operators. This way, the semantic relations between statements are made explicit and, given the compatibility of FOOL with RDF, virtually all the complex of our knowledge could in principle be made available on the Semantic Web as linked data. Traditionally, it is thought that the main semantic relation formal ontologies should make explicit and fully mechanizable is the one of entailment. But this cannot be the case if a language such as FOOL is employed, for decidability is no longer ensured. In fact, the semantic relations made explicit by a FOOL ontology are of a different kind, for they are relations of meaning relevance, or meaning closeness, between statements. It is not a long shot to think that, by devising appropriate measures of the linking patterns between statements, such relations could be mechanized, thus opening the way to new and possibly unforeseen results and applications.

Neighbourhood Semantics for Bayesian Abduction: Uncertainty and Negation of Probabilistic Beliefs

Nino Guallart

Probabilistic logic is a fertile field of research, both in logic, philosophy, and in practical areas such as artificial intelligence. Our particular interest lies on Bayesian approaches to probabilistic logic. Several proposals try to broaden probability, taking into account elements such as uncertainty or the reliability on the source. In this work, we develop a semantics for Jøsang's subjective logic, which is also related to Dempster-Shafer theory and to imprecise Dirichlet models. Jøsang's allows to deal with probability and uncertainty in such a way that the operations of subjective logic can obtain conclusions with well-defined probabilities and uncertainty, thus making this kind of logic ideal for non-ideal situations in which we are dealing with degrees of uncertainty. There is no specified semantics for this system, so the one that we propose is one based on neighbourhood semantics. We justify this choice instead of a more standard Kripkean one for the following reasons: neighbourhood semantics is able to adequately express lack of probabilistic belief and to express uncertainty. This have as a drawback the complexity of the model, that have to tackle not only with the probabilistic belief of events, but also with its uncertainty and its a priori belief, elements which are parts of what is called a subjective opinion. After the study of the interpretation of subjective opinions in neighbourhood semantics, we will tackle how this affects the interpretation of several logical operations of subjective logic, in particular deduction, Bayes' theorem and abduction.

Some Concerns with Totally Grounded Analogies

Marcello Guarini

David Godden and John Grey (2021) have written a scholarly, thoughtful, and rigorous treatment of what they call totally grounded analogies. In such analogical arguments, there is a deductive move that not only makes the argument non-monotonic, it is rendered anti-monotonic. I will argue that totally grounded analogies are, at best, the exception. Much of what comes under the heading of “analogical argument” should not be reconstructed as requiring a total grounding rule, and problems ensue if we insist on total grounding rules for analogy. The idea that plausible analogical arguments can have false conclusions is not permitted by totally grounded analogies, and an account of analogical argument needs to allow for that. Examples from science, mathematics, ethics, and law will be considered, and the importance of non-monotonicity will be stressed. At best, the sort of arguments we might refer to as totally grounded analogies are a kind of special case. That said, Godden and Grey are well motivated: they want to address the problem of redundancy and the problem of justification. I will argue that these problems can be addressed (and are being addressed in the literature) without requiring total grounding. While a non-monotonic treatment of analogical arguments leaves open the possibility that the conclusion may be false, such arguments can enjoy the kind of plausibility that other nonmonotonic arguments can enjoy. That is plausibility enough.

Epistemic Feelings in Decision-Making and its Integration into an Inferential Taxonomy

Rico Hermkes

Intuitive action and decision-making are essential properties of expertise and skilled performance. Such intuitive processes are not only drawn on an explicit knowledge base. Rather, tacit knowledge is involved in such processes. But tacit knowledge is not consciously accessible to the subject, which raises the question of how to ensure the validity of intuitive decisions. A solution to this problem can be provided by integrating epistemic feelings into a logic of tacit inferences. However, the interplay between such feelings and decision-related cognitions is unclear so far. The paper analyzes in which ways epistemic feelings contribute to ensuring the validity of intuitive decision processes and provides an integrative approach to how feeling and reasoning interact in the course of intuitive processes. As a result, intuitive processes can become fallible, and their investigation can be linked to research on human rationality.

Involving Cognitive Science in Model Transformation for Description Logics

Willi Hieke, Sarah Schwöbel, and Michael N. Smolka

Knowledge representation and reasoning is a well-established branch of artificial intelligence research that is concerned with the explication of knowledge about our world in form of logical formulae. This knowledge is used to perform reasoning tasks, which lets a logic-based AI system deduce consequences from its respective knowledge. A well investigated family of knowledge representation languages is called description logics (DLs), which are decidable fragments of first-order logic that can speak about graph structures. This means, models of DL sentences can be regarded as edge- and vertex-labeled directed graphs. There is a variety of algorithms to solve common reasoning tasks for DLs such as satisfiability of a logical statement. Many reasoning tasks can actually be reduced to the computation of a model of the knowledge the DL system possesses. Now, when it comes to explaining the reasoning results, one can often use a well-chosen model of the ontology to present to a human. However, the models generated by common reasoning algorithms are computed according to the algorithm’s optimization criteria and not with respect to human understanding. This can lead to models that appear artificial and might be hard to comprehend. In this paper, we address this issue by presenting an approach for making models of DL ontologies more intelligible to users by taking findings from cognitive science into account. The research goal is to identify potentially useful graph properties that resemble human thinking in order to transform given models from DL reasoner systems to more comprehensible models that satisfy these useful properties. To identify potentially interesting properties, we include data from existing behavioral experiments as well as logical and philosophical considerations.

Abduction in LLMs, the Issue of Real World Navigation

Mireille Hildebrandt

Are LLMs merely stochastic parrots that may infer reasoning patterns from our datatified language behaviours or should we expect them to develop reliable reasoning based on logic and causality? Taking C.S. Peirce seriously, I will raise the question of how reasoning relates to abduction and how language models relate to real world meaning. This will involve a third perspective to assess both reasoning and meaning, next to logic and causality. This third perspective is the performative effect of speech acts, closely related to the consequentialist dimension of pragmatism. I will argue that the utilitarian understanding of consequentialism pervades Anglo-American discourse, whereas the pragmatist understanding is better aligned with real world navigation. For LLMs to develop abduction they would need to develop what roboticists Pfeifer and Bongard called 'complete agency', meaning they would need to be built to survive in the real world without being under external human control. This, in turn, raises the issues of the intentionality (Brentano) of these systems and their 'conatus' (Spinoza), which cannot be assumed and seems highly unlikely. I will conclude that LLMs may become useful tools to the extent that their integration is not made dependent on manipulative business models, while we should not expect them to arrive at abduction, artificial general intelligence or complete agency. In the meantime it is key to acknowledge the abductive creativity of those who develop and deploy these systems and the way that LLMs may trigger and challenge such creative abduction.

A New Approach to Knowledge Discovery - Hintikka's Interrogative Model of Inquiry

Kaiyi Huang and Jian Wang

Abstract: Hintikka's interrogative model of inquiry is a scientific inquiry approach to unifying knowledge discovery and justification proposed for modern philosophy of science. This model presupposes conclusive conditions in the set of answers that can be sought during the inquiry process, and then advances the inquiry through strategic rules for answer selection within a priori knowledge. This paper will introduce the interrogative model step by step from its theoretical foundations to the constraints of its principles, and will illustrate the diversity of applications of the interrogative model through Hintikka's explanation of the conjunctive fallacy. First, the interrogative model is based on abductive reasoning and strategic rules for knowledge discovery and justification. Drawing on Peirce's ideas, Hintikka argues that abductive reasoning is an amplified reasoning and is the only way to introduce new hypotheses. Strategic rules indicate that the selection of information sources is traced, so that abductive reasoning is a rational procedure rather than blind guessing, which ensures the validity of abductive reasoning. Then, presupposition and prior knowledge are necessary for the application of the interrogative model. Presuppositions originate from the set of available answers and are necessarily present, and the presuppositions of questions and answers in turn limit the inquiry. A priori knowledge, on the other hand, is an essential part of the conclusive conditions, and in scientific experiments a priori knowledge consists of mathematical knowledge. The idea that the inquirer knows the sources of information and strategic selection in the interrogative model can also refine the prior probabilities in Bayesian inference to address the conjunctive fallacy. Finally, the interrogative model returns to the discovery context in the philosophy of science and is a new approach that can be applied in practical science. And the interrogative model, as a multidisciplinary product, can promote the development of multiple fields such as cognitive logic and artificial intelligence.

Matrix Modelling of n-Terms Systems

Ionel Narița

The systems of terms are represented using different methods like Euler or Venn diagrams. Such methods are limited by the number of terms, for instance, if a system contains more than three terms, then the diagrams become difficult to be built. Through the matrix method, we can represent systems with n terms, where n is a finite number. Using the matrix models, the relations concerning the terms of a system can be calculated. These models allow us to decide upon the value of the propositions or inferences with terms. For instance, we can discover all the valid moods of syllogisms with n terms. On the other side, the matrices can be used to

establish the validity of the inferences with numerical quantified propositions. Generally, inside of matrix models, a large variety of problems concerning the relations of terms can be solved.

Does Prediction Destroy Predictability? The Case of Financial Markets

Emiliano Ippoliti

Predicting stock markets is a problem that has generated many answers. According to one group of responses, it is impossible to accomplish this since the prediction would cause the market to behave in a way that would permanently depart from what was predicted, or it would "falsify" itself. There are at least two types of impossibility: logical (Morgenstern) or empirical (see the EHM).

A second class of responses argues that despite the 'bending effect' of predictions, it is still feasible to reach that objective. These responses contend that we can achieve it by demonstrating that there are fixed points (Modigliani) or that the prediction and market behavior will eventually converge (e.g., rational expectation theory). I expand this line of reasoning by showing that the performativity (MacKenzie) makes it possible prediction by an alignment between the 'ontic' and the 'epistemic' state of the markets.

A Non Monotonic Reasoning Framework for Human-Like Knowledge Invention

Antonio Lieto and Gian Luca Pozzato

Inventing novel knowledge to solve problems is a crucial, creative, mechanism employed by humans, to extend their range of action. In this paper, we present TCL (typicality-based compositional logic): a probabilistic, non monotonic extension of standard Description Logics of typicality, and will show how this framework is able to endow artificial systems of a human-like, commonsense based, concept composition procedure that allows its employment in a number of applications (ranging from computational creativity to goal-based reasoning to recommender systems and affective computing).

The framework relies on 3 main ingredients:

- a non monotonic extension of standard Description Logics (allowing to reason on exceptions to inheritance in standard knowledge bases)
- a probabilistic extension coming from the field of logic programming (the DISPONTE semantics)
- a cognitive heuristics known as HEAD-Modifier determining preference rules for the inheritance mechanisms of the novel concepts to be generated via commonsense rules.

We report the obtained results and the lessons learned of this research path in the context of model-based AI applications.

Internal Realism and Computational Model of Mind: A Realist Interpretation of the Ontological Relativity

Antonio Lizzadri

This presentation aims to explore the theoretical connections between the ontological model of reality known as "internal realism" and the so-called "computational" model of mind. These models are usually opposed, since internal realism is mostly interpreted as an antirealist metaphysical view - in which we can't go beyond our conceptual schema and we can only consider reality as fiction - while, on the contrary, the computational model of mind is mostly interpreted as a reductionist or scientist anthropological view, in which human mind is conceived only as the functional organization of the brain, that is to say of a machine.

I maintain that this opposition is not adequate and that it depends on a superficial interpretation of both models, that does not consider their possible theoretical connections. More precisely, I show that the computational model of mind can play an important explanatory role with respect to the ontological relativity, that essentially characterizes the internal realist view.

Not Just Toying Around

Joshua Luczak

Much of the literature on scientific models and model based reasoning is concerned with representational models. Despite their importance, distinct nature, and presence, toy models, on the other hand, which are a kind of nonrepresentational model, are rarely discussed. This paper hopes to remedy this situation. It aims to elevate the status of toy models: by making clear the distinction between toy models and representational models, by discussing the connection between user intentionality and scientific representation (i.e. when a model represents something), by highlighting and elaborating on ways in which Tatjana Ehrenfest-Afanassjewa and Paul Ehrenfest's urn model, their wind-tree model, and Mark Kac's ring model—all simple statistical mechanical models—have been used to reason about physical theories, and by explaining why they can be successfully used in these ways without performing a representational function.

Logic of Content - An Attempt at Formalizing Human Everyday Thinking

Piotr Lukowski and Konrad Rudnicki

Historically, logic was developed separately from cognitive science and vice versa, which caused a rift between these two fields. As a result, there is a critical lack of logical systems aimed at symbolic representation of natural language use and human everyday reasoning. In particular, humans do not reason by processing truth values, which is how truth-functional logics arrive at conclusions of reasonings. The purpose of this article is to address this problem and develop a non-truth-functional, which would allow for a symbolic representation of the way in which humans determine if something is true or false - by processing the contents of sentences. We create foundation for a Logic of Content. We present the new content implication connective with semantically defined content inference and discuss its logical properties, as well as confront it with empirical findings of cognitive science with regard to human reasoning.

Scientific Models as Tools for Epistemic Warfare. The Unwelcome Confusion between Static and Dynamic Aspects of Models in Science

Lorenzo Magnani

Scientific models are not only seen as helpful tools for finding new entities, rules, and theories or for understanding and explaining existing facts and theories, they are also given a variety of new names: from the classical ones, as abstract entities and idealizations, to the more recent, as fictions, surrogates, credible worlds, missing systems, make-believe, parables, functional, epistemic actions, revealing capacities. I will talk about these conceptual issues and highlight some of their epistemological flaws while also making use of current developments in cognitive science. With the aid of current findings from the fields of distributed cognition and abductive cognition, I will also critique fictionalism while reinterpreting the received idea of abstractness and ideality of models. I will provide cognitive and epistemological reasons to show how it is misleading to evaluate the role of models in science by adopting a puzzling confusion of static and dynamic aspects of the scientific activity. Epistemologists undoubtedly think that scientific models appear fictions when seen from a static standpoint, such as when they are presented in a textbook, however, I argue that when seen in a dynamic light, their fictional nature disappears. Finally, the innovative idea of "epistemic warfare" and its implications for objectivity and creativity in science will be used to reinterpret scientific models.

Standing on Thagard's Shoulders. Taking a Computational Philosophy of Science Perspective on Crossdisciplinary Knowledge Integration

Julie Mennes

In the past decades, more and more opportunities have been created for research across disciplinary boundaries, both within existing structures and via new programs and institutes. As a result, a significant part of contemporary research practices is now crossdisciplinary. There is a prevailing preference for types of crossdisciplinarity that involve knowledge integration (i.e. inter- and transdisciplinarity) rather than knowledge juxtaposition (i.e. multidisciplinary) because integration is widely considered essential for achieving scientific

break-throughs and solutions for complex societal problems. Yet, to this day, the notion of crossdisciplinary integration remains notoriously vague. This means that our picture of contemporary scientific practice is seriously incomplete and that we lack a solid foundation for the organization, management and evaluation of inter- and transdisciplinary research.

In this paper, I reflect on what a model of crossdisciplinary knowledge integration could look like. I start from Paul Thagard's cognitive science model of scientific problem solving, which is comprised in the computer program called 'PI' ('Processes of induction'). For this exercise to be successful, I assume that (i) crossdisciplinarity is a form of scientific problem solving; (ii) some problem solving processes involve knowledge integration; and that (iii) knowledge integration across disciplinary boundaries may differ from integration within disciplinary boundaries in scale and complexity, but not in nature. Next, I reflect on what features of Thagard's model would also be valuable as part of a model of CD knowledge integration, and what features and functionalities the latter should include that are not present in Thagard's model.

Abduction - Its Point and Reach

Gerhard Minnameier

The field of abduction is multifaceted, and views on it are diverse. An important question in this context is to what extent different notions of abduction are compatible or incompatible with each other. On the one hand, there are certainly different kinds of abductive reasoning. On the other hand, the term "abduction" has been used for various forms of ampliative reasoning which has also led to confusion, in particular between abduction and inference to the best explanation (IBE). Hence, there is not only the problem of differentiating and integrating forms of abduction in a system of abductive inferences, but also the one of delimiting the scope of abduction as such and against non-abductive forms of reasoning and cognition in general. The present paper attempts to solve these problems, based on a discussion of the forms of abduction brought to the fore by Lorenzo Magnani.

At first sight, the literature on abduction may appear somewhat confusing. A big problem in the past was that abduction had been identified with IBE, which, however, seems to constitute a form of induction (see Minnameier, 2004). Apart from this classic opposition and the confusion it brought with it, a most interesting and fruitful set of different conceptions of abduction have been suggested, in particular by Magnani (2009) and Schurz (2008; 2017). While Schurz's ideas have been discussed extensively in Minnameier (2017), the present contribution will focus on Magnani's suggestions and discuss them in this context. This may help to sharpen a few aspects of (different forms of) abduction.

The Use of Fuzzy Mathematics for Socio-Environmental Evaluation in Social Economy

Giulia Miotti

In this paper, I propose an analysis of an innovative model recently developed by the Community Foundation of Messina (a granting foundation in Southern Italy) which relies on the use of fuzzy mathematics to evaluate the economic, social and environmental impacts of given projects or enterprises in a specific context. I will appraise such model in the light of more general problems within model-building and model characteristics in economics.

Economics stands in a rather peculiar position within social sciences. On the one side, economics and economic modelling allow for the construction of highly-mathematized objects, thus providing a quantitative description of agents and phenomena within, for instance, markets. On the other, economics is also responsible for a qualitative account of the reality it intends to describe and predict. In this instance, it should account for the behaviour of economic agents and how it may affect the context in which they act. When it comes to this twofold nature of economics and economic inquiry, most models seem unable to account for both the quantitative and qualitative side of this discipline.

A different scenario seems possible within some experimental models in social economy, in which for the very nature of its activities (local rather global and tailored on specific contexts) models have to work on a smaller scale. In particular, I will show how the use of models relying on fuzzy mathematics allows for a more accurate description of the most evasive aspects concerning qualitative aspects of the contexts and phenomena described and their inherent complexity.

Interrogative Logic as Underlying Logic in Scientific Practices

Ángel Nepomuceno Fernández

According to Corcoran (1974), given a particular science (in a broad sense) that presupposes its own subject matter, both a system of demonstrative discourse and a system of reinterpretation of the corresponding language should also be proposed. This language can be a (specialized) fragment of ordinary language or a formal language. These three presuppositions are taken together from the underlying logic (of such science). So the underlying logic is not a mere system of logic but a kind of meta theory that can be studied by means of logical methods.

Then a question arises, namely, can be represented the underlying logic of any scientific practice by means of a “logic”? In this context a logic could be defined as a mathematical model integrated by

1. a (formalized) language,
2. an inferential mechanism,
3. a full semantics, that is to say, an interpretation of such language, usually in model theory terms.

On the other hand, Philosophy of Science had entered different interdisciplinary fields where Logic was often excluded from, so the role of underlying logic could be taken as a bridge between both disciplines.

In our proposal (interrogative logic as a framework for underlying logic), approaches to classical logic and its extensions, some epistemological issues the semantic tableaux procedure and the idea of inference as a game, converge, particularly the Hintikka's notion of interrogative game. So an interrogative logic, as a game of an active player (the inquirer) and a passive player (the model) is proposed as a framework that represents an underlying logic, which is certainly a way of model- based reasoning since in scientific practices the inquirer reasons according to a system of rules of inference about those facts that are modeled by the corresponding theory.

The structure of an extended interrogative game (interrogative logic) is composed by

1. the inquirer —correlate: the researcher—,
2. a first order language (fully interpreted) and a system of tableaux with extended rules (all rules together are the definitory rules) —correlate: the set of rules that govern the scientific practice in question—,
3. the model or oracle —correlate: the model of a background theory—,
4. a set of (possible) responses —correlate: a kind of logical space where presuppositions could occur—, this set contains subsets of formulas that constitute the winning strategies. Some properties of the framework will be proved.

To finish, concluding remarks and a short bibliography will be given.

A Classification of Abduction Based on Its Different Goals: A Proposal

Douglas Niño

Abduction can be seen as a genre from which perception, theoretical hypothesis, practical hypothesis, ludic interpretations, playful interventions, tactical manipulations, technological productions, among others are species. One way of characterizing this genre is to say that Abduction contributes to make “manageable” an uncertain situation by affording new information which recommends certain course of action. The “manageability” response depends on the target or agenda in course. In this sense, the manageability to which abduction contributes in perception is different from that of an explanatory hypothesis and these from non-explanatory strategic displays (technical, ludic, etc.), and so on. The purpose of this paper is to propose such classification based upon a recharacterization of what an agenda is and by whom is advanced. Gabbay and Woods (2003, 2006), and Woods (2013) have proposed that an agent in pursuing an agenda turns to certain cognitive resources such as information, time, computational capacity, and strategies. I would redescribe this in a more ‘naturalized’ manner. In a nutshell, agendas for beings like us have four features: (1) they are a type of result, (2) which is pursued through the selection from a type of resources (bodily and non-bodily), (3) during some type of time, and (4) according to certain standardized valuation grids (which establishes scales in which in (1), (2), (3) are insufficient, sufficient, or optimum in different grades and levels). I use type in the Peircean sense of ‘comprising variations’ (Short, 2007). A

type is a set of unactualized possibilities, whereas a token is an actualized possibility, an instance. Actions produce tokenized effects. In this sense valuation grids are standards, usually socially shared (accepted or imposed) and are the reference point for which a token effect is valued (for instance, if an agenda is valued as closed). The above requires, in turn, a characterization of what an agent is, her situated enaction, and particularly how she deploys her resources in order to advance and trying to close her agenda, which I will develop in the paper in detail. I would further propose that that after the classification of purpose, we can proceed to consider other criteria for classification.

A Thought Experiment to Prove a Multitude of Intelligent Worlds

Nikolai Omelchenko

In my view, the philosophical principle of George Berkeley (1685–1753) ‘esse est percipi’ may have the next interpretation: an object for its existence should be perceived by someone. The being of the object is needed in a subject as a witness, a thinking spirit which is able to see, feel, and understand the object. If this is true, then the Universe has an interesting structure: its being should be perceived by someone. For its existence, the Universe requires a mirror, an endless number of the mirrors that they could reflect its infinite properties and wonderful beauty.

Let us assume that there is no human who would be able to see an object, for example, the evening sunset, mountains, forests, fields. There is no human now or in the future. Then nature will turn out in the darkness. Only the mind contemplating nature will be able to release it from that darkness. Nature is needed in the thinking spirit to actualize, discover itself in the light and color of the reasonable perception.

In the cosmic scale, the principle esse est percipi presupposes an innumerable quantity of intelligent worlds and permanent self-reflection of nature. From this viewpoint, if sometime humankind ceases its way, then Cosmos also stops its existence for people. However, while there is at least one thinking structure in the Universe, nature cannot reduce to nothing. Nature gives birth to the new and new reasonable worlds in order... not to die. The Universe affirms and confirms its being by giving birth to every new reason. The presence of reason in the world proves the existence of nature. Homo sapiens is one of the witnesses of its physical existence.

Solving Problems by Searching Failed Attempts for New ideas: A New Computational Model of Insight

Thomas C. Ormerod

Although much is known about what makes problems difficult to solve, the ways in which people come up with new ideas during problem-solving is much less understood. Theories of idea generation are problematic because they must provide a solution to the frame problem, in which choices of where to explore fruitfully for new ideas in a potentially infinite space of possibilities must somehow be constrained to areas of relevance that cannot be pre-determined prior to commencing exploration. Existing proposals for idea generation for the class of problems associated with insight typically operate by presenting solutions or solution hints among a finite set of possibilities, the task of the solution model being to discriminate the correct solution information from distractors. I contend that this class of explanation lacks both plausibility and generalisability. Instead, I present PRODIGI (Progress and Discovery of Ideas In Generating Insights), a computational model implemented in ACT-R that seeks new possibilities in the products of its own failures to solve, comparing the properties of failed attempts, extracting dimensions of variability that differentiate alternative failures, and using these dimensions to discover new possibilities. I will illustrate how PRODIGI solves the frame problem with a computational model and empirical data that test it of the Cards problem, an analogue of the challenge faced by Mendeleev in creating the periodic table of chemical elements.

Idealization and Abstraction in Scientific Modeling

Demetris Portides

It is commonplace that Science does not describe the systems of the world in their full detail and complexity. Most frequently the general principles of theory are inter alia supplemented with simplifying assumptions and used in the construction of models. It is frequently admitted

that model-simplifying assumptions involve two distinct characteristics: the omission of features of the phenomena from the scientific representation of respective target systems (often referred to as abstraction) and the modification of features that are retained in the representation (often referred to as idealization). This admission dictates a question: how could the two kinds of assumptions be defined so that the given definitions lead to a clear-cut distinction of the two? In this paper I argue against one of the prevailing answers to this question, which I label conception-X. I spell-out the main characteristics of conception-X and argue that it has two important consequences both of which are questionable. I show why conception-X fails to meet its purpose by arguing that its main characteristics and its two consequences are untenable. Finally, I suggest a different way to distinguish the two processes, as two particular forms of selective attention.

An Action Based Model of Logic

Klaus Prätör

This paper is looking for a real logic of action, not only of action sentences and trying to use it as a basis for a general model of logic.

It starts with an application of logic in the field of action: Artificial Intelligence planning systems - the situation calculus (McCarthy / Hayes). This approach was dropped because of the frame problem, the impossibility to infer in first order logic the state of non changed attributes in a new situation - and was replaced by search algorithms like STRIPS, which uses Means-End-Analysis. This was widely regarded as the departure of AI-planning from logic. The paper propagates that this is only true for a logic of propositions about situations, not for a real logic of actions, which models the changing acts of the situations (what also STRIPS does), not only the description of the changed situations.

An early approach which conceives logic generally as a system of reasoning acts is constructivism. "Logical rules are action rules, according to which we construct and transform propositions" (Lorenzen 1948). Here predicate logic is modelled as a dialogue game, where the tasks of reasoning are divided between a proponent and an opponent. Dialogical logic is modelling the set of intuitionistic logic (without ‚terbium non datur‘). But there are some drawbacks, especially regarding the connection to informational models. Replacing the conception of a two-person-game by a cooperative distribution of reasoning acts makes it better compatible. This is not far from the task logic of Kolmogorov, which gives a semantic to intuitionistic logic, and can more easily be connected to informational concepts, logic of action, planning and Means-End-Analysis.

Abductive Inferences in Perception and the Representational Formats of Perception and Cognition

Athanasios Raftopoulos and Demetris Portides

Cognition affects a stage of perceptual, visual processing called early vision through abductive-non-discursive inferences. A visual experience as if X is before a viewer is prima facie a reason for believing that there is an X before them only because in one's world such a visual experience is reliably related to an X being before them. This is not an inference from a set of propositions to another proposition, the conclusion, but rather a state transition driven by the input, the makeup of the perceptual system, and the viewers' cognitive states, in the way described by the theory underlying dynamic, neural systems where an input is eventually drawn to one of the system's attractors.

However, even if no discursive inferences are involved in late vision, cognitive states affect the output of early vision during late vision and, thus, modulate perception. Therein resides a serious problem. Cognitive states are cast in a digital symbolic representational medium, while the states of early vision with which cognition interacts are thought to be cast in an iconic or analog symbolic medium. The problem concerns the way cognitive states cast in terms of digital symbols could interact with perceptual states cast in an iconic medium. Cognitive states, qua digital symbolic states, do not have the requisite iconic structure to be able to affect iconic perceptual states. Cognitive representations are discrete or atomic, have no referentially relevant internal structure, and their contents do not describe or specify any properties of their referents. This is why they cannot affect perception whose iconic states have a rich internal structure that maps naturally to the representatum.

In this paper we propose a solution arguing that cognitive states, such as perceptual beliefs, that affect perceptual processing are either parts of visual working memory (VWM) or of Visual Long-term memory (VLTM), and that VWM and VLTM comprise iconic elements. The cognitive states in some forms of memory that affect perceptual processing have an iconic component and it is through this component that they interact with iconic perceptual states.

Towards an Ontology of Capitalist Knowledge Production: Beyond the Metaphysical Epistemic

João Romeiro Hermeto

Knowledge cannot be simply discussed from a metaphysical perspective, in a time in which many authors push forward and normalize the term knowledge-based economy (KBE), it is imperative to investigate its concrete sides of knowledge production and distribution. While knowledge is being unceasingly privatized, intellectual property theory takes this fact for granted and proposes multiple forms to accommodate the paradoxical situation between social knowledge production and private appropriation of knowledge. This paradoxical condition deriving from intellectual private property relations within the capitalist mode of production also has the crucial function to enable and justify contemporary capitalist power relations. Hitherto virtually all theories of intellectual property have assumed what they need to explain, thus a Marxist critical assessment of it, in which capitalist relations are exposed from a historical materialist perspective, has been neglected. Researching this topic unveils the possibility of a very multidimensional scope, which presents not only a broad range of mainstream analyses of intellectual property but also some historical analysis, the critique of political economy, the political economy of media, some indigenous and African perspectives, different analyses on the development of thought, ideas, and cognition, and much more. Insofar as it contains such multiple perspectives, it strives to present the totality of intellectual property within the capitalist mode of production instead of focusing on the phenomenological moments of copyright, trademark, patents, etc. Thus, it unveils the dialectics of capitalist relations and power that enforces and necessitates intellectual property as the privatization of knowledge while the production of knowledge presupposes a constant collective and social development which cannot be reduced to privatization.

Modelling Insight: Process or Phenomenology?

Wendy Ross and Thomas C. Ormerod

In this paper, we argue that the shift in research on insight problem solving from how people solve problems that are structured in a certain way to which problems and problem solution types elicit a feeling of insight was not theoretically driven but was rather determined by the exigencies of neurocognitive testing which required low latency, multi-trial problems. This focus on phenomenology has led to a fundamental neglect of the questions of how people solve an insight-type problem and replaced it with an investigation of the metacognitive effects of so-doing. We argue that this shift leaves unanswered the questions of how new knowledge and understanding is generated and that the assumptions of current models unwittingly commit researchers to as yet untested theoretical assumptions. We propose that this shift in the direction of the research field has led to a disproportionate focus on outcome over process and a worrying aggregation of idiosyncratic tendencies. We will conclude with a call to generate multiple research path-ways – one examining the phenomenology of the feeling of insight and the other returning to tackle unanswered questions about the process of generating novel understanding.

Detection of Presuppositions for Falsification of Applied Logic Predictions

Konrad Rudnicki and Piotr Lukowski

In order to create an accurate psychologicistic applied logic, researchers need to translate logical terminology to terms of empirical science. This project is designed to operationalize the logical presuppositions in terms of observable neural phenomena. We hope to achieve that by measuring brain activity in response to sentences that violate presupposed knowledge. We outline the experimental design and connect it to the already existing studies in neuroscience. In particular, we fall back on the predictive coding paradigm, which describes how the human brain anticipates incoming new information and reacts to mismatches between anticipations

and reality. Mismatches between hypothetical presuppositions and presented stimuli may be used to determine whether some propositions were presupposed or not. As a result, we hope to obtain a tool that can be used for falsification of predictions made by applied logics (e.g., paraconsistent or non-monotonic logics) with regard to actual human reasoning.

The Art of Cognitively Seductive Visualizations: The Case of Covid-19

Anna-Mari Rusanen

Visualizations played significant communicative and epistemic roles in the Covid-19 pandemic. Visualizations, such as “The Flattened Curve” shaped, conceptualized and gave a language for understanding the disease. In this paper, I’ll analyse the Covid-19 visualizations in a light of their cognitive, inferential and evidential properties. I’ll present a rough taxonomy of diverse types of Covid-visualizations, and analyse, how their cognitive properties (should have impact(ed) for their evidential and inferential uses. Particularly, I’ll focus on three different exemplars of visualizations (“The BBC Map”, “The Flattened Curve”, and “The Mortality due to the Covid-19” chart), which all played significant communicative and epistemic roles during the pandemic. Further, I’ll argue that these visualizations raise novel data and algorithmic literacy skill requirements for the sufficiently reliable epistemic use of them. Finally, I’ll conclude by discussing on the wider societal significance of visualizations in a light of Covid-related policy-making.

The Role of Anticipations Based on Axiological Information in the EC-Model of Abduction

Alger Sans Pinillos

This talk presents the role of anticipations based on axiological information in the eco-cognitive model of abduction (EC-Model). In many cases, the data require a type of judgment that reevaluates the fact or circumstance that hosts the epistemic development of the cognitive agents. Anticipations are powerful cognitive resources for adopting forward-looking stances based on future expectations that enable change in present conditions. Likewise, expectations are prospective postures whose plausibility is based on context and past experiences. Thus, anticipations allow agents to imagine themselves in situations different from their current circumstances. The relationship between anticipations and expectations can be abductively characterized as the integrating mechanism of the agents' predisposition to act based on lived experience and the current perception of the environment. Thus, the prospective plausibility of anticipatory expectation is identified with abduction because of its epistemic value as a stabilizing hypothesis that guides the actions that should be taken to achieve the desired future. The case explored is the anticipation of not wanting to go to a place based on the bad expectations caused by cases of discrimination, such as the disaffection to go to museums.

The Narrative Function of an Embodied Imagination Between Scientific and Literary Thought Experiments

Valentina Savojardo

The aim of this work is to highlight the narrative function of the scientific thought experiment, in relation to the use of an embodied imagination, which is always connected to the dimension of the body. Imagination constructs stories and in this way the thought experiment exemplifies certain aspects of reality: always thought experiments are presented as a narratives and the narrative dimension is connected to the cognitive dimension, in which imagination plays an essential role. Reassessing the narrative function of the thought experiment will allow us to investigate the complex relationship between scientific thought experiment and narrative fiction. Bearing in mind some important differences between the two fields, an attempt will be made to highlight the connection between scientific and literary thought experiments in relation to the embodiment of narrative art. In particular, bearing in mind the mechanisms of mirroring, the subject of numerous studies in the field of Embodied Simulation Theory, it will be shown how the use of scientific and literary thought experiments depends on our ability to identify with them with our bodies.

Towards a Situational Account of Verbal Irony

Cameron Shelley

Verbal irony is a complex phenomenon in which people say things they don't literally mean, to achieve various discursive and social goals. Cognitive theories of verbal irony have focused on verbal irony as a mainly linguistic phenomenon, related to other forms of irony only in a distant or abstract way. By contrast, this paper sketches a situational account of verbal irony, on which verbal ironies are closely related to situational ironies. A situational irony is a state of affairs that people would describe in terms such as, "It is ironic that ...". On this account, verbal ironies cannot be wholly understood without reference to situational ironies. Also, in general, verbal irony gains much of its status as a kind of irony through this connection. A situational account of verbal irony is outlined here, adapting the blended spaces model of cognition proposed by Kihara (2005). Simple examples are analyzed, and steps for future work are considered.

The Development of the Semiotics and Affordances of Indicator Diagrams and Thermodynamic Work Cycles in the Material and Theoretical Cultures of Early Steam Engines

Alok Srivastava

The thermodynamic work cycle is a central piece of model-based reasoning and diagrammatic reasoning for investigating and designing energy conversion processes in engineering, physics, chemistry and biophysics. The model and diagrams of thermodynamic work cycles are applied to material processes and is a commonly used logic and language in the investigation and design of these processes. In the early 1800s, Sadi Carnot developed this machinery of the thermodynamic work cycle by analyzing the indicator diagrams generated by recording devices mounted on steam driven engines to trace defects in performance of the steam engines. However this episode in scientific discovery and conceptual change has not been studied concurrently for the affordances and semiotics of indicator diagrams and development of model-based reasoning. The affordances of the indicator diagram were developed and articulated by Sadi Carnot's clarification of the semiotics of the traces across many types of engines. The traces of the movement of the piston during a work-cycle had to be abstracted as referring to a conceptual and reference work cycle. This work resulted generation of the epistemic objects of the scientific and engineering disciplines of thermodynamics. In this paper, I intend to trace the sequence of steps of development and the evolution of local affordances of indicator diagrams into the semiotic, logic and language of engine design and in turn the metaphysical affordances into the semiotics, logic and language of thermodynamics as developed by Carnot and his successors. The overall goal of this paper is to develop tools for elucidating the specific steps of development of effective ontologies, logics and language from diagrammatic reasoning to explanatory and model-based reasoning during episodes of scientific discovery and conceptual change.

Counterfactuals, Models, and Scientific Realism

Fabio Sterpetti

Counterfactuals abound in science, especially when one reasons about scientific models. Indeed, very often in science the theoretical claims we arrived at by reasoning about models are not intended to hold in the actual world, rather those claims are intended to hold in some highly idealized models, which can be regarded as possible worlds that can be quite remote from the actual world. In many cases, some of the models one deals with in science appear to have assumptions that are metaphysically impossible. This means that in science one has to deal with counterfactuals with a metaphysically impossible antecedent, i.e., counterpossibles. According to the standard semantics for counterfactuals, all counterpossibles are vacuously true. But scientific practice shows that counterpossibles are not always regarded as vacuously true by scientists. Counterpossibles in science are indeed often taken to be non-vacuously true or false. To do justice of the use of counterpossibles in science, some authors think that we should adopt a non-standard semantics for counterfactuals, i.e., a semantics that allows for impossible worlds. It seems difficult to reconcile such a view on the role played by counterfactual reasoning in science with scientific realism. Nevertheless, some authors think that it is possible to maintain scientific realism even if one acknowledges the relevance of counterfactual reasoning in science. The price to pay is that one has to adopt a less straightforward conception

of realism. In this view, scientific realism should be interpreted as the claim that counterfactuals do not provide an accurate representation of the actual state of models' targets, rather they provide us with genuine modal information about possible states of those models' targets. In this paper, I will analyse two of the main difficulties that arise if one wishes to defend the adoption of a realist perspective on science along those lines.

Lorenzo Magnani's Contributions to the Study of Abductive Inference

Paul Thagard

Charles Peirce introduced the investigation of abductive inference (abduction) in the late nineteenth century. Since then, the leading writer on the topic has been Lorenzo Magnani, who has produced many articles on the subject and three books: *Abduction, Reason, and Science: Processes of Discovery and Explanation* (2001); *Abductive Cognition: The Epistemological and Eco-Cognitive Dimensions of Hypothetical Reasoning* (2009); *The Abductive Structure of Scientific Creativity: An Essay on the Ecology of Cognition* (2017).

My aim in this talk is to review and assess this impressive body of work, attempting to answer questions such as the following:

- What is the relation between creative and justification aspects of abduction?
- What does abduction tell us about causality and explanation?
- How do philosophical approaches to abduction connect with artificial intelligence and neuroscience?
- What do ecological considerations add to the understanding of abduction?
- How central is abductive inference to human and machine cognition?

The Principle of Ecthesis in Hypothetical Reasoning

Bruce Thompson

Ecthesis is a rule or procedure by which one syllogistic form may be transformed into another. An ecthesis replaces one of the premisses with the denial of the conclusion, and then replaces the conclusion with the denial of the replaced premiss. This procedure is known to be validity-preserving for deductive syllogisms. This paper shows that it is also validity-preserving for non-deductive syllogisms as well. To accommodate the kinds of quantifiers that Charles S. Peirce felt were needed in the representation of non-deductive arguments, the paper uses a vastly expanded syllogistic system in which intermediate proportional quantifiers are included. Even in this expanded system, all deductively valid syllogisms can be derived from the AAA-1 syllogism using a small number of validity-preserving transformations. These transformations include conversion simpliciter, obversion, and principles following from subalternation in Aristotelian syllogistic logic. The paper proposes two syllogisms, IAA-2 and IEE-2, to serve as axioms for deriving abductively valid syllogistic forms using the same transformations that applied to deductive syllogisms. The resulting derivable syllogisms show (1) that the number of abductive forms is quite large, but not so large that abductive reasoning can be accused of permitting any conclusion whatsoever to follow from any premisses whatsoever; (2) that the set of deductive syllogisms are contained within the set of abductive syllogisms, and (3) that ecthesis is a derivable validity-preserving principle for abductive syllogisms, and may therefore be used as a handy short-cut in computational models attempting to link relevantly related forms of abductive argumentation to each other.

Thinking, Fast and Slow, in the Life-World: A Comparison of D. Kahneman and A. Schutz's Renditions of Common Sense

Joaquin Trujillo

This paper comparatively examines the renditions of common sense Daniel Kahneman (K) provides in his New York Times bestselling book, *Thinking, Fast and Slow* (TFS) (2011) and Alfred Schutz harvests through his phenomenology of the life-world (*Lebenswelt*) of the natural attitude. The project reviews K and S's interpretations of common sense, lays out their basic correspondences and differences, and concludes with observations about their complementarity.

Creativity via Transduction: Associative Abductive Reasoning Through the Lens of Model-Based Reasoning

Sandra Visokolskis

This paper focuses on a matter that Nancy Nersessian raised quite rightly: in the history of the philosophy of science there has been a systematic error, i.e., the one who states that “discoveries cannot derive from reasoned processes” (Nersessian 2008: 11). But, while Nersessian takes along with Lorenzo Magnani the path of delving into the creative aspects of model-based reasoning, we propose in this paper to include the modeling processes proposed by the two aforementioned authors, within the framework of a variant of the different versions of abduction proposed at the time by Charles Sanders Peirce, what we have come to call transduction.

The approach proposed here constitutes a modelistic representation of the transductive process (i.e., transduction operates constructing a creative model, contemplating three stages: similarity, analogy and explanatory causal abduction), in terms of a blend between intuitive acts and abductive inferences. However, in contrast with this philosopher, (1) instead of instinct dominating intuition, we speak of expert knowledge and, (2) we distinguish two stages during abduction: a first one that makes the formation of hypotheses possible, and a second one, relative to the selection and adoption of one of such hypotheses. While Peirce considers that the formation of hypotheses (stage one) is merely instinctive, we will assume that this task -which we will call 'transductive' as a particular and primitive case of the abductive process- is much more sophisticated and complex, and is dominated by a cluster of non-deductive activities and skills such as: iconic visual inferences, analogies, metaphors, inductive generalizations among others, all contributing to the construction of one or more hypotheses that explain the emergence of some creative insight, in response to a problem that motivates and drives the creative process.

Chorological Abductive Inferring: Case Studies of Tracing Spatial Dissemination of COVID-19

Piotr A. Werner

COVID-19 did not disappear in the third year (2022) of the global pandemic. On the contrary, the number of infected several times exceeded the highs of previous years, but the greater morbidity was not accompanied by a relatively comparable number of deaths. Some studies showed that the SARS-CoV-2 virus impact e.g., in CEE EU countries characterizes the seasonal intensity as temperatures fall or rise of relative humidity. All researchers agree that the number of COVID-19 infected people is only an estimate based on the volume of tests performed, and that the true numbers are usually much higher. Modeling spatial interactions might help prevent the spread of COVID-19 because it is intrinsically a spatial phenomenon. The gravity models used in this investigation to simulate the regional spread of the COVID-19 epidemic are based methodologically on previous empirical studies. The proposed methodology uses techniques for modeling spatial interactions due to the epidemics described above, which are a direct result of the number of contacts between individuals. The COVID-19 pandemic can be studied regionally using spatial diffusion methods as well as population potential models (spatial interaction models) and visualized using geographic information system software. Empirical verification and geovisualizations are based on available recent population and pandemic statistics that are possible to acquire from national health services. Methodologically, this type of modeling and simulation aimed at reconstructing a factual situation can be defined as abductive chorological inferring.

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