A Modal Perspective on Proof Dynamics

Patrick Allo

Core aim of this paper is to focus on the dynamics of real proofs by introducing the block-semantics from [Batens, 1995] as a dynamical counterpart for classical semantics. We first look briefly at its original formulation - with respect to natural deduction proofs - and then extend its use to tableau-proofs. This yields a perspective on proofdynamics that (i) explains proofs as a series of steps providing us with an insight in the premises, and (ii) reveals an informational dynamics in proofs unknown to most dynamical logical systems. As the latter remark especially applies to Amsterdamstyle dynamic epistemic logic, we consider a weak modal epistemic logic and combine it with dynamic modal operators expressing the informational proof-dynamics (as a natural companion for the informational dynamics due to new information known from dynamic epistemic logic). The motivation for this approach is twofold. In a general way it is considered as (a first step in) the reconstruction of the proof-dynamics known from adaptive logics (revealed by its block-formulation) within a modal framework (i.e. using a relational structure); in a more restricted way it aims at the explicit application of some results on omniscience formulated in Batens' paper on block-semantics.

Coping with Meaning
Towards an Evolutively Plausible Computational Semantics

Asunción Álvarez

One of the most common objections laid against the computational approach to the study of the mind is that it fails to take into account the evolutionary factors which have shaped the development of the cognitive system. In this paper, I will examine the possibility of providing a computational account which is also sound in Darwinian terms as regards the question of mental representation – that is, the relation between mental symbols and their meanings. Classical computational theories of mind have traditionally tended to resort to covariance and functionalist accounts of meaning in order to provide a semantics of mental states. I will argue however that a teleological evolutionary account of the meaning of mental symbols, such as the teleosemantics postulated by Ruth Millikan, would provide a more plausible naturalistic semantics, in particular when combined with a neural-networks model of mental processing.

In the first part of the paper, I will give a brief summary of the classical computationalist account of mental processes, based on the Turing Machine model, and the functionalist semantics which it usually resorts to in order to explain the relationship of mental symbols to actual reality. I will also describe the Parallel Distributed Processing approach, which is modelled on neural networks and as such appears to be closer to biological and evolutionary reality than its alternative. In the second part, I will sketch out the outline of Millikan's teleosemantics and its evolutionary background. Finally, in the third part, I will argue that the greater biological plausibility of the PDP model is reinforced when combined with a teleofunctional semantics, and discuss the advantages that such combination would have over traditional Turing-machine functionalism.

The dynamic nature of meaning

Claudia Arrighi and Roberta Ferrario

The central issue of this paper is that of showing that there is not such a thing like the exact meaning of a word or expression, but meaning is something that gradually evolves from the dynamic processes of communication. Starting from this assumption, we present a draft of a theory whose aim is twofold: on the one hand, it describes how the meaning is formed as a mental state of individual agents (private meaning) and, on the other hand, it shows how a public meaning emerges from the interaction of agents. As a possibility to represent private meaning we take a flexible semantic network, where words (or concepts) are connected one another when they frequently present themselves together in the experience of the agent. Hence, when agents find themselves in a communicative situation, they start with different backgrounds and thus with different semantic networks to represent the private meaning they ascribe to a certain word or expression; in order to be able to understand each other, they need to agree on a public meaning that is then the result of a negotiation process. It is important to notice that these two "sides" of the matter are strongly interconnected, since not only the public meaning evolves as a compromise between different private meanings, but the private meanings are also continually reshaped by these intercourses. Our goal is to provide a viable philosophical approach for a dynamic definition of meaning. A multitude of works in this direction has been put forward by computer scientists dealing with problems of heterogeneity of sources of information. In fact, computer scientists are often in need of making different systems (that have their information stored and organized in totally different ways) communicate. Sometimes different systems just store the same information under different labels (names) or, vice versa, use the same label for different types of information; given all this, it should appear immediately evident why a better definition of meaning is so important even for computer science. This paper argues that a suitable solution for both disciplines could be reached by a more systematic characterization of the processes of meaning negotiation.

Intelligent Alarm Correlation and Abductive Reasoning

Stefania Bandini, Alessandro Mosca and Matteo Palmonari

The main aim of this paper is to present a way to improve the efficiency of an intelligent alarm correlation system (ACS) by means of an abductive reasoner. The ACS is integrated in a complex architecture (SAMOT) that performs monitoring and control tasks over tracts of highways.

SAMOT's architecture consists of cameras for data acquisition, Video-Image Processors (VIPs - providing local interpretations of traffic anomalies), the knowledge-based alarm correlation module, and a control actions level.

VIPs are able to detect many interesting anomalous situations concerning traffic flows and the correlation of alarms detected allows to provide a more global view of the system; nevertheless, there are useful information about traffic that are not provided neither by VIPs nor by the correlation of their outputs due to technological and efficiency constraints.

On the basis of a specific theory on the domain explanations of anomalous traffic patterns can be provided taking into account those situations not directly detected by VIPs. The integration of the comprehensive view obtained by correlation with specific domain knowledge allows to abduce from the observed anomalous traffic patterns other significant situations.

The experience of traffic operators allows to build a theory of abducible explanations that exploits the knowledge of the use context of the system. The abductive module can trigger the activation of proper further control actions, both automated and manual. Inferences previously draft may be kept or retracted after these further controls with a formal nonmonotonic mechanism very similar to usual human control activities.

The paper will focus on the formal description of the abductive model. The correlation module of SAMOT has been modelled within a propositional modal formalism, named ST-Logic, which will be adopted for the abductive reasoner as well.

Finally, some remarks about stratified interpretative cycles made possible within such a formal framework will be addressed.

An argument against computationalism

Eduard Barbu

Computationalism claims that a system (human beings included) has cognitive states by implementing the right kind of computation. The centrality of computationalism in the study of cognition was forcefully challenged before by many authors. Nevertheless its position in cognitive science seems to be very solid.

The argument against computationalism we will present is based on a well-known Putnam's argument against functionalism. Putnam's argument targets the functionalism in his implementation aspect. If we are allowed to consider arbitrary disjunction of physical states as realization of the formal states of an automaton, then we will obtain the result that any open physical system is implementing any finite state automaton (FSA). This leads to the equivalence between functionalism and behaviorism.

We will start by exposing the motives that lead Putnam, many years ago, to advance the hypothesis the mental states are identical with functional states. After shortly introducing the notions that help us to understand Putnam's argument (FSA, maximal state, the principle of implementation, etc.) we will present the argument. The argument has two parts. In the first part Putnam proves that any open physical systems implements any inputless FSA. In the second part Putnam extends his result to FSA with input and output.

We will accept the critique of Chalmers, namely that Putnam does not establish that every open physical system implements any FSA with input and output but a weaker result, that is any open physical system implements a trace of the execution of a FSA. We will show then that even this weaker result is sufficient to undermine functionalism, and implicitly computationalism. For this we will consider a human being performing a cognitive activity over a period of time. If this human being has cognitive states in virtue of implementing a computation, then according to the weaker form of Putnam's argument it is certain that any open physical system will have cognitive states.

Authentic Robots and Inauthentic Daseins

A. Barua and M. Satpathy

In this article, we present a sympathetic understanding of Heideggerian approach to technology and its impact on context dependent embodied human subjects, i.e. Heideggerian Daseins. In addition, we explore how in the realm of the modern day cyber-technology, the semantic gap between the inauthentic Daseins and relatively authentic robots is becoming thinner and thinner.

Music to Our Ears: A Required Paradigm Shift for Computer Science

Dave Billinge and Tom Addis

We previously studied the way people communicate musical experience. We concluded that discussions do lead to some appreciation of other's internal experience. However, nobody can have direct access to another's internal experience so we suggest that the only way in which it can be understood is through inference. In order to create a computer model of this process we have to rely on formal languages, which are all referential, that is, they utilise denotational semantics. We adopt Wittgenstein's Tractatus, which is a theory of description based upon referential semantics, to provide a model of computer languages. This model highlights the problem that computer languages in fact have an untenable dual semantic. This dual-semantic creates insurmountable demands on computer representations of the world and by implication on computer models of the human cognitive process. However, what could resolve this tension is if computers-as-agents, and people, constructed models of the world that were merely sufficient to meet the needs of surviving in a social world. This process requires a notion of inferential semantics as opposed to referential semantics. We propose a formal computer model of inferential discourse based on a belief system and we detail experiments to detect the discourse features of this inferential process.

Exemplar-Based Explanation

Rens Bod

The idea that phenomena can be explained by means of exemplars or explanations of previous phenomena has been often proposed in the literature (cf. Kuhn 1970, Giere 1988), but never formally worked out. To the best of our knowledge, no formal model exists that explains new phenomena by means of previous ones, or that describes how problem solutions can be reused to explain new cases in science. This paper proposes such a model which combines partial derivations of previous phenomena into derivations of new phenomena. We first show how our model successfully provides explanations for idealized phenomena from classical mechanics using a corpus of derivations of previous phenomena. The main advantage of using partial derivations rather than laws is that we do not have to explain each new phenomenon from scratch if we have derived a similar phenomenon before. However, derivations of real-world phenomena and systems typically involve approximations, normalizations and corrections that do not follow from laws but that are stated by ad hoc rules and approximation schemes (cf. Cartwright 1983). We show that exemplar-based explanation aptly integrates theoretical laws and ad hoc rules. By using previous derivations of systems from fluid mechanics and hydraulics, we show that a range of other real-world phenomena and systems can be explained, such as weirs, notches, nozzles and nappes. We argue that exemplar-based explanation is not only used in actual scientific practice but that we even cannot do without it in explaining real-world systems. We also suggest that our model may aid scientists to come up with novel and rather unconventional explanations as it considers any combination of previous subderivations. Finally, we argue that our exemplar-based model of explanation generalizes over both the syntactic, covering-law view and the semantic, set-theoretical view, as it effectively combines theoretical and phenomenological knowledge.

Introducing Chogic: A Primitive Part of the MARMML Machine Reasoning System

Selmer Bringsjord, Kostas Arkoudas, Paul Bello, Marc Destefano, Bram van Heuveln and Yingrui Yang

Herbert Simon is on record as being irrationally sanguine about the progress of AI. (Exhibit A would have to be his comments at the 1956 kickoff conference at Dartmouth, where he proclaimed that "thinking machines" would soon be upon us.) However, in a keynote address at CAP at CMU, given shortly before he passed away, Simon admitted that AI had made surprisingly slow progress, even in the area of machine reasoning (an area his own Logic Theorist inaugurated). He recommended there that AI and machine reasoning start to base its designs on what brilliant humans do, and gave some preliminary data on the attractiveness of natural deduction to human reasoners. Simon's Dream (that machine reasoners one day match first-rate human reasoners) is one we think our MARMML system can bring AI appreciably closer to. In this talk, we describe MARMML, by focusing on two proper parts thereof, the Chogic system, and Athena, and on an intelligent agent that has been built under contract for ARDA, Slate; this agent's "brain" is in part MARMML. Our focus is specifically achieved by laying out a hybrid logic that includes four novel inference rules involving an interesting interpretation of the modal operators Diamond and Box.

Embodied consciousness: A view from General System Theory

Mariana Claudia Broens, Maria Eunice Quilici Gonzalez, Luis Felipe de Oliveira, Pim Haselager

We investigate in this paper the nature of consciousness based upon the theory of Complex Systems (Bertalanffy, 1968; Wienberg, 1975; Peat, 1991; Jensen, 1998; Haken, 1999; Gregersen, 2003) and Gibson's ecological approach to information. We characterize consciousness as an embodied, embedded, self-organized process in which action, attention and dispositions to grasp relevant information occupy a special place.

Starting from the hypothesis that consciousness emerges out of the dynamic coordination of different brain areas (Parvizi & Damasio, 2001; Edelman & Tononi, 2000; Bressler & Kelso, 2001), we argue that there is a more basic, embodied, kind of consciousness which we share with other animals. This can be understood as a self-organizing process of information tuning that occurs between organisms (including the very primitive ones, like the unicellular creatures) and their environment. According to this view, information available in the environment constrains the domain of possible actions of the organisms, structuring an element that unifies perception and action in the domain of living agents. As we are going to argue, the notion of affordance allows a promising understanding of the dynamics of selective attention involved in this basic kind of consciousness, organized in accordance with criteria of relevance that allow life preservation.

From this perspective, the dynamic coupling between perception and action constitutes a fundamental element of consciousness. One of the main objectives of this paper is to inquire into the potential and limitations of the mechanistic view on consciousness, as developed in Cognitive Science (specifically in robotics) and contemporary Philosophy of Mind.

Ethics of artificial consciousness

Jan Burian

In the past few years many researchers opined possibility of creation of artificial structures with abilities (especially intelligence) equal or superior to human in relatively near future. Behavior of such structures will be very complex, unpredictable and thus possibly dangerous.There arises practical motivation for the research of artificial consciousness and its ethics.

Current neurophysiology shows correlation between objectively observable processes in the body and the subjective conscious experience. It is practical to suppose existence of consciousness outside our subjective experience as an aspect of irreducible and difficult formally describable processes. But due to limitations of current scientific methodology we cannot satisfactorily explain the link between the conscious mind and the body. New methodological approach is proposed in this article.

Possibility of artificial consciousness is discussed. Consciousness cannot be an aspect of sequential processing of information represented by discrete symbols. Alternatively, connectionist systems are processing information distributed in large parts of the whole system. Consciousness unlike the intelligence cannot be artificially simulated because simulation refers to objective description of processes. Consciousness is considered to be an aspect of processes that can be also objectively described, but consciousness is not the product of such processes. It seems more likely to be the way, how the process is going on. The term artificial consciousness can mean only the consciousness of artificial structures, and not that the consciousness is artificially produced. Evolvable hardware is a feasible medium for methods inspired by biology. Artificial evolution can evolve structures with complexity comparable or higher than the complexity of human brains. It could be practical to suppose the possibility of some analogy of consciousness in complex biologically inspired structures.

What does mean the term "superior" when we talk about structures with abilities superior to human? It needn't mean only quick and universal inference, learning etc. but also analogy of human empathy or sympathy, an insight in internal experience (including suffer and joy) of other conscious structures. There can be many fitness strategies in the (artificial) evolution. Cooperation can overpower self-enforcement. Cooperation can be even more successful when analogies of empathy or sympathy are involved. Assumption of artificial consciousness base possibility of autonomous decisions about rules to follow, with subsequent impact on the AGI themselves. It could be an analogy to human responsibility and ethics.

External and internal representations of road pictographic signs

Brigitte Cambon de Lavalette, Patrick Brezillon, Charles Tijus, Sébastien Poitrenaud, Christine Leproux, Alexandre Lacaste and Marie Bazire

The usage of road sign often requires an interpretation process that relies on an external representation realized by a cognitive system and combined with (more or less implicit) knowledge in the decision-making process.

Road signs have been designed to help drivers managing road and traffic rules. Drivers use a combination of a specific shape, a specific color, a specific object, an action category (e.g. slow down). As a result, a road sign, as a whole, is considered as a literal sentence and a logic proposition for driver's decision-making.

However, drivers may not build a correct meanings of road signs, even when the pictured objects are easily recognizable. There is at least two reasons for this observation. First, the context in which road signs are interpreted is not correctly analyzed. Second, the drivers' interpretation of road signs evolves with the accumulated experience in a kind of heuristics that work almost always.

We discuss in this paper the gap between explicit knowledge about road signs and the implicit knowledge that is used when driving. We hypothesize that there is no match between patterns of external road signs and internal representations of meaning. Conversely, there is a contextual building of what decision must be taken given the presence of a sign in a given situation.

We first show that road signs components, as words, denote concepts with varied and contextualized meanings. Second, a task analysis approach is used in order to understand how road signs are interpreted in context. We use a context-based formalism called Contextual Graphs (Brézillon, 2003) for modelling the implicit knowledge encapsulated in situation that helps the making decision. The interpretation can be understood as a process that integrate contextual elements with domain objects in an intertwined way that can be related to the chunk of knowledge of Schank and Abelson (1982) or the proceduralized context of Brezillon (2003).

Why Cognition Can't Be Computation

William A. Cameron

Computation has become a central concept in the study of cognition. Although writers may disagree as to whether cognition and computation are synonymous, most are agreed that what they mean by 'computation' is a process of manipulation of explicit representations and it is this sort of process that is taken as a model for some aspect, or module of human cognition. I shall argue that this analogy is misguided. Not only is the term 'computation' misapplied by this analogy, but by this misapplication the term has become empty.

'Compute' is an intentional verb. Whatever analogies there may be between cognitive mechanisms and mechanisms within serial or parallel or analogue computers, the latter devices are artefacts devised by humans to aid them in their computations, or in other processing, which may include the simulation of some cognitive processes. To speak instead of 'combinatorial processing' would preserve all of the distinctions required for the current debates whilst restoring the intentional nature of a computational act. Human agency is necessarily intentional. Within a functional description of human cognitive processes, perceptions amend and produce representations, representations amend other representations and representations cause action. Whether these functional processes, realised in the human brain, are apt for description as computational will depend on our characterisation of computation and this is the main goal of this paper. It may be that a choice made within human agency depends on a computation and that this computation is carried out as a separate act of agency *in the head* of the agent. However, although this computation is carried within the central nervous system of the agent it is not part of the cognitive processes of agency. A computation is an act of agency, an act which is itself an outcome of cognitive processing of intrinsic representations within human agency. The result of a successful computation is available for perception by the agent.

Ontology for Information Systems. Artefacts as a Case Study

Massimiliano Carrara and Marzia Soavi

Ontologies for information systems are usually classified according to two dimensions: their level of detail and their level of dependence on a particular task. One can distinguish between *Top-Level Ontologies* – less detailed and independent on a particular task – and *Domain Ontologies* – more detailed and specific on a particular task. The first ones are descriptions of the most general concepts as, for example, entity, material entity, space, time, matter..., while the second ones deal with a more specific domain like medicine or engineering. The goal of this paper is to analyse one central concept of a *Top-Level Ontology*: i.e. the concept of *artefact.* The relation is partitioned in four sections. After a sketch (sec. 1) of some intuitive and common sense reasons concerning the importance of artefacts as an ontological category and some features we usually assign to this kind of objects, we consider (sec. 2) the characterisation of it given by two of the most common Top-level Ontologies: *Cyc* and *Wordnet.* We outline some difficulties there are in their characterisation of it. In the second part of the relation (sec. 3 and sec. 4) we propose an *elucidation* of artefacts using the notions of *copy, original object,* and *author*. We distinguish three kinds of *copies*: *replicas*, *rigid copies*, and *functional copies*, and two kinds of *original objects*: *absolute original objects* and *relative original objects.* Following A. Thomasson [*Fiction and Metaphysics*] we state some different ontological dependence relations among (these different kinds of) copies, original objects, and authors. In this way we want to elucidate how technical artefacts, can be discriminate from artworks.

Rational Perception and Creative Processes in Cognitive Science

Arturo Carsetti

Cognitive processes can be considered, in the first instance, as self-organising and complex processes characterised by a continuous emergence of new categorisation forms and by self- referentiality. In order to understand the inner mechanisms of this kind of processes we have to outline a theory of more and more sophisticated forms of organisation. We need, for instance, to define new measures of meaningful complexity, new architectures of semantic neural networks, etc. In particular, we have to

take into consideration the genetic and "genealogical" aspects that characterise the inner development of cognitive symbolic structures.

However, cognition is not only a self-organising process. It is also a co-operative and coupled process. If we consider the external environment as a complex, multiple and stratified Source which interacts with the nervous system, we can easily realise that the cognitive activities devoted to the "intelligent" search for the depth information living in the Source, may determine the same change of the complexity conditions according to which the Source progressively expresses its "wild" action. In this sense, simulation models are not neutral or purely speculative. The true cognition appears to be necessarily connected with successful forms of reading, those forms that permit a specific coherent unfolding of the deep information content of the Source. Therefore, the simulation models, if valid, materialise as "creative" channels, i.e., as autonomous functional systems, as the same roots of a new possible development of the entire system represented by mind and its Reality.

Thus, at the level of simulation models, it appears necessary now to extend the condition of predicative activity, as defined by Quine, by admitting the necessary utilisation of specific abstract concepts in addition to the merely combinatorial concepts referring to symbols. For this purpose we must count as abstract those concepts that do not comprise properties and relations of concrete objects but which are concerned with the inner articulation of the intellectual tools of invention and control proper to the human mind.

A contradiction in Frege's Grundgesetze ?

Paola Cattabriga

The conditions for proper definitions in mathematics are given, in terms of the theory of definition, on the basis of the criterions of eliminability and non-creativity. As a definition, Russell's antinomy is a violation of the criterion of eliminability [Behmann, 1931; Bochvar, 1943].

Following the path of the criterion of non-creativity, this paper develops a new analysis of Comprehension schema and, as a consequence, proof that Russell's antinomy argumentation, despite the words of Frege himself, does not hold in Grundgesetze der Arithmetik.

The principle of comprehension can be regarded as a schema originally conceived for defining sets. For this special function, we are legitimate in considering the comprehension principle under the point of view of the theory of definition. The rule for defining a new operation symbol requires to have a preceding theorem which guarantees that the operation is uniquely defined. If the restriction on the uniqueness is dropped then a contradiction can be derived. The self-referring characteristic of Russell's antinomy turns out to be a procedure which forces a set to be twice defined, we are dealing with a set whose elements belong and do not belong to the set itself, dropping thus the above uniqueness condition.

Instantiating Deliberative Democracy: Project PICOLA (Public Informed Citizens Online Assembly)

Robert Cavalier

This presentation will discuss the theory of Deliberative Democracy in the context of recent attempts to instantiate that theory in concrete settings. In particular, the presentation will look at Jim Fishkin's concept of a Deliberative Poll and its potential to revitalize the practice of democracy.

A highlight of the presentation will be an overview and demonstration of an aspect of CMU's PICOLA that is customized to facilitate online versions of Fishkin's Deliberative Poll. This program, developed in conjunction with the Institute for the Study of Information Technology and Society and the Center for the Advancement of Applied Ethics, features a multimedia, high telepresence environment for next generation Computer Mediated Communications. It is a compelling example of "Applied Political Philosophy."

Behaviour, mental processes and theories: Prisoners in the room of our Beliefs (and our computations)

Luciano Celi

Starting from our common experiences – behaviours which lay behind mental processes based on more or less justified beliefs – we try to demonstrate that our epistemological access to the world can lead us to wrong inferences that could make us prisoners in a room or… leave us without petrol! (§§ 1-2)

A short mention, in a somehow historical way, to conceptual theories as a background, is useful for a better understanding of a recent cognitive theory's (so called Theory-Theory) role: it links ordinary, everyday reasoning and scientific reasoning, where we try to make an example that comes from medical diagnosis (dermatology) (§ 3)

The previous example also has a ‘computer version’ and leaves us with an implicit (and open) question: why are doctors often so confused about the pathway of reasoning which leads them to correct diagnosis, when the same kind of reasoning is really clear enough to describe it in an algorithm for neural networks? (§ 4)

The conclusion, with no final answer, shows possible risks of reductionism and/or functionalism.

Knowledge Representation Progress in the Brief Web History

Paolo Ceravolo and Ernesto Damiani

The World Wide Web has got a brief history (about fifteen years) but the evolutionary thread of its basic knowledge representationnparadigms is already a long one. In this paper we want to propose a brief analysis of the evolution of knowledge representation forms on the Web. This analysis will be carried out by a strict comparison between philosophical positions and technical organization of data supporting web technologies. Practical examples come rom the direct experience developed by our research group working in the MAPS project, a software engineering project supported by Basic Research Fund (FIRB) of the Italian Research Ministry. If first Web was a information magma where relations between concepts were free, the current Web is becoming more and more like a knowledge

representation base where relations rest on a foundation. This means that any semantic definition gets a value only if relying on a foundation structure, and semantic inference gets its weight according to this foundation. These notions have to be take in account developing Semantic Web and Web Services applications. Keywords: Knowledge Representation, Semantic Web, History of the Web.

Conceptual Spaces and Artificial Consciousness

Antonio Chella and Salvatore Gaglio

The paper deals with a robot made up of a stereo head and an anthropomorphic hand operating at the Robotics Laboratory of the University of Palermo. The software architecture controlling the robot is organized in three computational areas: the “subconceptual”, area, the “conceptual” are a and the “linguistic” area. Several hints from consciousness literature have been taken as source of inspiration for the design guidelines of the software architecture.

Modelling Lakatos's Philosophy of Mathematics

Simon Colton and Alison Pease

Lakatos's `Proofs and Refutations' is a beautifully written dialogue about the way in which mathematics evolves. We believe that this work lends itself well to implementation, as it (a) is richly detailed and a highly original and impressive piece of work, (b) is open to criticism and extension (especially as it was the first attempt to characterise informal mathematics and is therefore likely to be incomplete); and (c) enables us, via its dialogue format, to model social processes (as opposed to many scientific discovery programs which model the thought processes of an individual). We argue that, in accordance with the computational philosophy paradigm, implementing Lakatos's theory has enabled us to improve upon it.

Our model is an agent architecture consisting of a number of students and a teacher, in the style of Lakatos's dialogue. Each agent has a copy of HR, Colton's automated theory formation program. Students send conjectures, concepts, counterexamples, or requests such as barring a specific object from the theory, to the teacher. The teacher sends requests to the students such as `work independently`, `send a concept to cover counterexamples [x,y,z]', or `modify faulty conjecture C'. The students use the methods prescribed by Lakatos, which show how counterexamples can be used to modify a faulty conjecture and proof.

We describe our implementation and discuss the questions which have arisen and our answers, including extensions to Lakatos's theory and a more fine-grained approach to some of the methods which he identifies. We argue both that the questions are important, as they coincide with questions philosophers such as Feferman have asked about Lakatos's work; and that our answers improve Lakatos's theory according to Thagard's criteria of consilience and simplicity.

Philosophy of science and the ethics of AI and robotics

Roberto Cordeschi and Guglielmo Tamburrini

The import of the philosophy of science on various ethical issues arising in AI and robotics is illustrated here by reference to warfare applications of both fields, starting from the so-called “electric dog”, the ancestor of phototropic self-directing robots, designed in 1912, and later on constructed by the USA researchers John Hammond, Jr. and Benjamin Miessner. Early discussions of this automatic device vividly illustrate the long-term connections between warfare technology and scientific investigations on the mechanistic modelling of adaptive and intelligent behaviours.

First, if the newborn, remote control radio-directed boats had been fitted with a device similar to an electric dog, these boats could automatically direct themselves toward enemy targets. Enthusiastic descriptions of this self-directing device were given in 1915 (during World War I), in connection with its possible applications as an "intelligent" weapon. Interestingly, the "intelligence" of this artifact, a so-called "dog of war", was chiefly attributed to the lack of emotional features hindering human operators, foreshadowing in this respect contemporary discussions about the alleged advantages of so-called "intelligent weapons".

Second, the epistemological significance of this self-directing robot was initially noted by biologist Jacques Loeb in 1918. He called the electric dog an "artificial heliotropic machine", and argued that the actual construction of such a machine supported his own theory of animal phototropism, insofar as a machine behaving like a living organism and organized as prescribed by a theory of that organism behaviour is a test for the theory's plausibility.

Epistemological and military motives of interest for automatic machines have been intertwined in major later developments too.

The method of testing behavioral theories through self-adapting machine models was called "synthetic method" by psychologist Kenneth Craik, who studied warfare applications of automatic machines in the early 1940's. The "synthetic method" has enjoyed increasing popularity in the explanation of animal and human behavior up to the present time. And the ethical implications of those machines were vigorously explored by founder of Cybernetics Norbert Wiener. It was another major conflict, World War II, "the deciding factor", as Wiener put it, for the development of cybernetic machines. Dissenting with AI pioneer Arthur Samuel, Wiener envisaged "disastrous consequences" of automatic and learning machines operating faster than human agents.

Similarly to what Wiener undertook in connection with cybernetic machinery, and physicists in connection with nuclear weapons, nowadays AI researchers and roboticists should go outside their technical communities, and make public opinion aware of dangers connected to applications of their work, insofar as their specialized knowledge brings these dangers out in ways that are not evident for the general public. Actions of this sort are aptly illustrated by reference to machine learning, to what we call "AI-complete problems", and to the problem of ensuring normal functioning conditions for machines.

First, one would like to have a guarantee that after training on some tasks a robot will learn to behave as expected most of the time, without bringing about the "disastrous consequences" that Wiener contemplated in awe. But theoretical guarantees of this sort,—it is pointed out in connection with so-called supervised inductive learning—, are very hard to come.

Second, autonomous robotic agents envisaged in the framework of military research projects will have to solve "AI-complete problems", that is, problems whose correct solution paves the way to the solution of any other AI problem. Recognizing surrender gestures and telling bystanders apart from hostile agents are cases in point, as both require contextual disambiguation of gestures, understanding of emotional expressions, natural language interaction, real-time reasoning. Human-level performances on these tasks are a far cry from current AI research efforts.

Third, designers of AI and robotic mechanisms are careful to note that their systems are expected to work properly in normal task environments only. Tests are usually conducted in isolated experimental settings or by computer simulations based on theoretical models of task environments. The absence of unforeseen disturbing factors in complicated real environments, especially in erratic warfare scenarios, is often conjectured on this basis only, that is, without direct or extensive tests "in the wild".

Evaluating Traditional, Hybrid, and Distance Approaches to Teaching Deductive Logic

Marvin Croy

This presentation will compare the teaching of an introductory deductive logic course under three conditions: traditional, asynchronous, and hybrid approaches. The traditional instruction (TI) approach consisted of standard classroom instruction with no electronic technology involved. The asynchronous version (also referred to as distance education (DE)) consisted of no classroom instruction and all learning occurring across the internet. The hybrid approach (HYB) consisted of classroom instruction supplemented with the same electronic resources provided to the DE students. Results from two sections of each type of instruction are compared in respect to learning (pretest and posttest), exam performance, attitudes, and persistence (drop out rate). These results are subjected to analyses of statistical significance.

After a brief demonstration of interactive java applets developed for teaching deductive logic via a virtual learning environment (WebCT), the results of the comparative evaluations will be shown. These results are taken as preliminary and as early steps in a long process of evaluating and incrementally improving the quality of teaching and learning in the deductive logic course. At this stage it is clear that the HYB students surpass the DE students on almost all measures. Nevertheless, the data provide some indication of how the DE course can be improved. Some discussion will also focus on every philosophy department's responsibility of empirically documenting the effectiveness of technologies introduced into teaching. One conclusion of this presentation is that, since the effectiveness of different types of instruction varies with local conditions, including characteristics of both students

and instructors, philosophy departments that introduce innovative technologies into their courses have the responsibility to empirically evaluate those technologies.

Biorobotic experiments in the scientific understanding of adaptive behaviours: epistemological and methodological issues

Edoardo Datteri and Guglielmo Tamburrini

Biorobotics has contributed in significant ways to scientific research in various areas of biology. Distinguishing features of the biorobotics strategy of explanation include the realization of a robot *based on a theoretical model* of the biological system under examination, and *model-based comparisons* between biological and robotic behaviours. Some theoretical models of adaptive behaviours were corroborated or falsified on the basis of biorobotic experiments. Biorobotic investigations play useful heuristic roles in biology, leading up to the discovery of new biological phenomena.

Biorobotic approaches in biology give rise to distinctive epistemological and methodological problems, which are variants of classical epistemological and methodological problems addressed by the philosophy of science in connection with more traditional scientific enterprises. What kinds of theoretical models in biology lend themselves to biorobotic investigation? What scientific explanations of biological behaviours can be probed by means of biorobotic experiments? Which methodological problems arise in the process of building and operating a robot for the purpose of testing a biological hypothesis?

This paper explores the variety of ways in which biorobotic experiments connect to theoretical hypotheses about adaptive behaviours. A wide range of biorobotics experiments is reviewed, emphasizing their impact on hypotheses to be tested, auxiliary hypotheses, and background knowledge. A classification of these experiments is proposed along the dimensions of falsification, corroboration, discrimination between competing hypotheses, heuristic role in the discovery of new phenomena, refinement of the intended domain of some scientific hypothesis, evaluation of the correctness of the robotic implementation with respect to the model to be tested, development of more accurate and precise measurements of some behavioural regularity. Another category of experiments concerns the selection of relevant *ceteris paribus* conditions in order to isolate experimental environments from "external" disturbances.

These epistemological and methodological considerations are illustrated by reference to case-studies worked out in the framework of robotic projects at a robotics laboratory in Pisa.

Defining and using deductive systems with Isabelle

F. Miguel Dionísio, Paula Gouveia, and João Marcos

There are several systems to automatically and/or interactively prove theorems of given deductions systems. In general such systems deal only with one specific deduction system (for example for propositional and predicate logic, temporal or other modal logic, or for higher order logic). The system Isabelle is a generic theorem proving environment that allows for the definition and use of deduction systems for any logic of interest. The deduction rules are either natural deduction rules or sequent style rules. In this way, using only this environment, it is possible to define and experiment different logics, since the user may choose the deduction rules he/she wants.

Obviously, some technical knowledge is needed for the task of using Isabelle in order to define and experiment with new logics. However, it is our experience that only a few main concepts are, in fact, essential. The authors have been involved in teaching a logic course for Mathematics and Computer Science undergraduate students. The system Isabelle has been used for representation and experimentation of natural deduction systems for propositional, predicate and modal logics.

Students learned how to define logics and how to prove theorems of those logics. Most students were able to deliver the final project that included the definition of a (new) hybrid logic, involving quantifiers and modalities.

In this paper we briefly describe the basic concepts needed to define and experiment with a logic.

Philosophy of Information, a New Renaissance and the Discreet Charm of the Computational Paradigm

Gordana Dodig-Crnkovic

The role that computers play today can be seen in light of the following dichotomy: on one hand, they are tools for computing/ saving of information (local) and on the other hand they are communication tools (non-local). The usage of computers as tools for computation leads to a trend of "catalogization"/ formalization/ systematization as seen in e.g. ontology engineering and automated discovery. Sciences, business, administration...all is to be formalized and systematized. At the same time the possibility of fast and easy communication leads to the insights that local solutions/ ontologies/ models are not sufficient and not necessarily compatible with each other.

Contrary to the previous mechanistic ideal of industrial-technological era, Computing/Informatics has successively developed to a very much human-centered discipline. The insight in the limitations of the formalization/ mechanization project

has led to a new awareness of the human character of knowledge and even its connection to value systems (ethics) and the totality of cultural context.

Ontology of each theory is always embedded in natural language with all of its ambiguity. The attempt to automatize the communication between different ontologies meets the problem of concepts with heterogeneous semantic origins. Coming from different universes, concepts that spell the same may have a continuum of meanings. The formalization complex met in semantic web or ontology engineering is thus closely related to the natural language semantic continuum that in its turn reflects the totality of the culture.

The emergence of a common context necessary to assure the minimum “common language” in terms of basic concepts is a natural consequence of this process of intense communication that happens in parallel with computationalization of almost any field of human activity thinkable. In that way a need and potential for a new Renaissance, where sciences and humanities, arts and engineering can reach a new synthesis, is created.

On the Importance of Teaching Professional Ethics to Computer Science Students

Gordana Dodig-Crnkovic

We can notice that the general public awareness on ethical aspects of technology is increasing. The high level of media attention given to computer-related disasters in technical systems such as the explosion of Arianne V in 1996 and the Therac-25 computerized radiation machine overdoses has increased interest in Computer Ethics.

Engineering has a direct and vital impact on the quality of life of people. Accordingly, the services provided by engineers must be dedicated to the protection of the public safety, health and welfare.

A code of professional ethics appears when an occupation organizes itself into a profession. It is central to advising individual professionals how to conduct themselves, to judging their conduct, and to understanding of a profession.

Most engineering takes place within profit-making organizations that are part of a complex structure of societal and regulatory constraints. Engineering Ethics is therefore relevant for the majority of people within Computing. Research Ethics or Educational Ethics apply to those professionals in Computing who are active within those fields. Many other branches of Ethics may as well apply such as Healthcare Ethics and similar for some of Computing professionals.

Of course the field of Computing has its own particular ethical problems that are important to address. Therefore a specific field of Computer Ethics has developed. It is vital to recognize that prudent ethical judgment is a crucial integral part of professional skills.

The aim of this analysis is to shed light upon the significance of teaching ethical issues in the field of Computing. It argues that ethics education should be incorporated into computing curricula. The experiences from the course Professional Ethics in Science and Engineering given at Mälardalen University in Sweden are presented.

Can vision be computational?

Rosaria Domenella and Alessio Plebe

In the last twenty years artificial image processing has become closely connected with the psychological and philosophical inquire about the human visual perception. This has raised the preliminary theoretical question if natural vision can be considered as a computational process. In this work we argue that this question should be better defined, because the two main terms, “computational” and “natural vision” are both too vague, and by adopting different meanings, different answers can be given. A broad sense of ”computational” may give affirmative but trivial answer. An other common use of this word is the obvious connection with the computer, but here again the role of the machine is not unique among researchers, and deserve further analysis. We think one of the possible sense of “computational” most fruitful in the understanding of human vision is related to the computation actually done by the brain for seeing, sustained by biological neurons. As far as concerning the meaning of “vision” for humans, one of the main difficulty for answering that question is to accommodate between the idea of vision as object recognition and the phenomenal experience. This, in our view, is the greatest challenge for a computational account of vision.

Applications of Anti-Realist Metaphysics to the digital world

Matthew J. Dovey

Over the latter half of the 20th century we have been engaged in building a world whose reality subsists in, for want of a better term, the world of electronic circuits, beginning with the development of computer systems and now, network computer systems such as the Internet, World Wide Web and GRID. At the beginning of the 21st century this "digital world" permeates many of our lives. However, we only have a rudimentary comprehension of the ontological and metaphysical foundations of the new “digital worlds” which we are building and in some sense living within. We currently exist in a somewhat uneasy and almost Descartian duality with this “digital world” [2]: aspects of out lives subsist either completely or partially within the “digital world”; whilst we ourselves exist completely outside of it. This external existence outside of the “digital world” raises a number of unresolved issues about what constitutes truth within this reality. The lack of a full understanding or even proper

awareness of these issues may often result in uneasiness and misconceptions with this new technology. Also, without full awareness of such issues, we may not realise the full potential of this domain. Despite the novelty and youth of these “digital worlds”, traditional instruments of metaphysics can prove to be extremely useful in shedding light and improving understanding of the “digital world”, albeit with a Wittgensteinian sting in the tail. Conversely the mutability of the “digital world”, permits it to be a very good medium for modelling the consequences of metaphysical theories. This paper examines how ontology and metaphysics from the idealism of Liebniz and Berkeley to the anti-Realism of Wittgenstein and Dummett can be used to explain our relationship with the digital world and help explain the problems that occur in using and developing solutions in information technology, and offer new solutions and options.

Compositionality, the Language of Thought, and the Dynamic Map of Thought

Marius Dumitru

Within the research area of internal and external representations in cognitive science, theories accounting for the structured character of the mental thought medium are to be seen as relevant for the foundations of artificial intelligence. It is my conviction that a better understanding of the mental thought medium within the context of representational theories of mind can provide a solid starting point for attempts to deal with knowledge representation in artificial systems. Compositionality is a key feature of mental representational systems. I am interested in the way in which the compositionality of mental representations is or is not exclusively explained by the existence of a syntactically and semantically combinatorial language of thought. I want to argue that the compositionality of mental representations can equally be explained by the existence of a syntactically and semantically combinatorial dynamic map of thought. More specifically, I think that the explanation in terms of a language of thought is based on the structural characteristics of an external medium, i.e. a language to be learned, and not on intrinsic structural characteristics of a mental representational system. I am not here discussing connectionist architectures as an alternative way to classical symbol systems in supporting systematically structured cognition. I am not saying that classical architectures are superior to connectionist ones; in this paper, I remain agnostic about that. I am rather surprised that proponents of explanations in terms of a language of thought consider these as exclusive explanations, intrigued by the suggestion that human thought may actually inherit its putative systematicity from the grammatical structure of human language itself, but inclined to say that there is a dynamic map of thought intrinsically respecting the principle of compositionality and that explanations in these terms are to be regarded as the right ones in the context of classical cognitive architectures.

What is Embodiment?

Roy O. Elveton

Well-known difficulties with classical symbol-processing models of human common sense reasoning have led to the exploration of various alternative models of human cognition and their implementation. One of these models, modest in its aspirations, but radical in its departure from more traditional architectures, is Rodney Brooks' conception of mobile autonomous agents ("Creatures"). I will argue that in employing the term "embodiment" in identifying his approach to human reasoning, Brooks runs the risk of confusing "embodiment" with complexly organized and causally embedded functional entities. When understood within the framework of contemporary European philosophy, an increasingly important resource for various members of the cognitive science community and the source of several recent attempts in the cognitive sciences to develop a more realistic model of human cognition, embodiment should be more plausibly defined by several distinctive structures that are absent from Brooks theoretical and experimental designs. While the implications of Brooks' attempt to develop models of cognition using a goal-directed, environmentally embedded and "engaged" form of intelligence raises in fact an important challenge to classical AI, one that is forcefully expressed in Brooks' own statements, the actual engineering and philosophical content of his notion of embodiment falls dramatically short of a more fully developed view of embodied consciousness that can be plausibly drawn from the philosophical sources Brooks wishes to keep at a distance.

Interactive diagrams for Charles Peirce’s theory of signs

Priscila Farias and João Queiroz

The computer’s impact on philosophy is welknown (see Bynum & Moor 1998). The use of computing technology in philosophical research includes a large range of topics and applications. Computer technology related to research on Peircean philosophy, however, has been, almost without exception, restricted to digital resources and databases, like versions of books and manuscripts (e.g., CD-Rom version of *The Collected Papers of Charles Sanders Peirce*), digital encyclopedias and dictionaries (*Arisbe*, *Digital Encyclopedia of C.S.Peirce*, *The Commens Dictionary of Peirce´s Terms*), on-line forums and courses (*Cyber Semiotic Institute*, *Virtual Centre for Peirce Studies at the University of Helsinki*, the *on-line forum for discussion of the philosophy of Charles Peirce and related topics*), and websites (*The Peirce Edition Project*, *Grupo de Estudios Peirceanos*). None of those applications are tools for investigation and testing of theory and hypothesis.

This article presents the first results of a research on computational strategies for the visualization of sign classification structures and sign processes. The focus of this research are the various classifications of signs described by Peirce. Two models are presented. One of them concerns specifically the 10–fold classification, while the other deals with the deep structure of Peirce's various trichotomic classifications. The first is *10cubes*, an interactive 3–D model of Peirce's 10–fold classification. The second is *3N3*, a computer program that builds equivalent diagrams for any n–trichotomic classification of signs. We are specially interested in how a graphic design methodology, associated with computer graphic resources and techniques can contribute to the construction of interactive models, that serve as tools for the investigation of C.S.Peirce's theory of sign.

The Role of the Internal and External Representations in sustaining Creative Processes

Alberto Faro and Daniela Giordano

By studying cognition from the perspective of the dynamic systems theory, the brain functions by using patterns arising in a What-Where plane. Developmental approaches assume that the brain functions by manipulating symbols that re-describe or re-represent (RR) at the conceptual level what the perceptual system executes in an unconscious way in response to the environmental stimuli. Further conceptual re-descriptions allow the mind to invent new solutions to the problems. The main criticism to RR is that it implies the existence of some entity in the mind that re-represent symbolically the world starting from the perceptual networks, whereas the criticism to the dynamic systems approach is that it is not rich enough to explain how the brain is able to carry out complex activities, especially the ones aiming at the creation of new patterns that have a developmental nature. We start from the position that the dynamic systems point of view is suitable to explain how humans learn behaviors by coordinating the neuronal groups populating the mind according to global internal representations, but we argue that some re-representation activity is needed too to explain how the mind, aided by external representations such as drawing and sketching, may accomplish complex creative tasks such as designing and painting. In the paper we show how the creative activities require that these two brain attitudes should operate jointly to solve new problems or enhancing previous solutions. In doing so, an account is proposed that contributes to extend the pattern theory and dissolves the "ghost in the machine" present in the RR approach. Our analysis is based on the embodiment hypothesis of the mind. The embodiment assumption is extended by considering that the cognitive processes take place at both individual and the social levels. In particular we show that concepts are created and reused by communities (e.g., community of design practices, community of learners, etc.) according to mechanisms analogous to the ones used in the individual creativity. Some evidence is provided supporting the proposed account.

The role of computers in scientific research. A Cognitive Approach

Roberto Feltrero

It is a commonplace in philosophy of science to think about computers as mere tools that increase the quantitative power of scientists and their methodologies. It is argued that whatever a computer is used for, it can be replaced by humans solving differential equations. Therefore, computers can not provide any epistemically relevant novelty to scientific inquiry.

It is a commonplace in the sociology of science and technology to think about computers as tools that enhance our cognitive capacities. It is argued that computers and their tools provide their users with capacities to generate amounts of cognitive work not available to the brain of an individual, not even to a group of brains in a finite time. Therefore, by means of computers, human being can reach cognitive tasks unreachable so far.

None of these two claims is completely true, however, none of them can be entirely dismissed. A cognitive framework is necessary to properly understand the cognitive role of computers and to shed light on this controversy clarifying the cognitive and the epistemic roles of computational tools.

An extended distributed cognition approach is proposed in order to clarify this complexity among the roles of computers as tools for cognitive activities. It will be the focus of this paper to apply the distributed cognition perspective to better understand the new roles of computers in scientific cognition and, therefore, their methodological and epistemic consequences. It will be claimed that computers extend our possibilities to apply new methodologies not available with the cognitive tools used so far. A case study in evolutionary simulation models will be used to illustrate these assertions. The use of these computational tools —which do not fit the classical idea of computation— can provide scientists with new methodologies for modeling whose epistemic relevance, however, has to be restricted to the cognitive domain.

Steps Towards a Computational Metaphysics

Branden Fitelson and Edward N. Zalta

In this presentation, the authors describe their work in developing the new discipline of computational metaphysics. Our method is to implement an axiomatic metaphysics in the automated reasoning program OTTER.

In the first part of the talk, we review the basic principles of E. Zalta's axiomatic theory of abstract objects. This metaphysics is couched in a syntactically second-order modal predicate calculus with one new atomic mode of predication ("xF",

read: x encodes F) . The basic comprehension principle for the theory asserts that for every condition on properties, there is an abstract object which encodes just the properties satisfying the condition. Identity conditions are also given: abstract x and y are identical iff they encode the same properties. Comprehension and identity conditions for properties, relations and propositions are also given. Then, objects such as Forms, Monads, concepts, possible worlds, natural numbers, etc., are defined and the basic principles about them are *derived* from the proper axioms.

In the second part of the talk, we show how the resulting theory can be represented in OTTER's first-order syntax. The basic idea is to use a multi-sorted first-order language, with sorts for objects, properties, propositions, etc. Once the axioms and definitions are represented in OTTER's syntax, we then formulate the claims we expect OTTER to prove. OTTER then uses classic theorem-proving techniques, such as hyperresolution, to derive a contradiction from the negation of the claims we want to prove. The resulting computational system can *find proofs* of interesting theorems of metaphysics that are consequences of the axiomatic theory, such as the theorem that every possible world is maximal.

Presence - Its Ethical and Epistemological Implications

Luciano Floridi

The paper introduces a new model of telepresence (henceforth simply presence). First, it criticises the standard model of presence (cf. International Society for Presence Research , http://www.ispr.info/) as epistemic failure, showing it to be inadequate. It then replaces it with a new model of presence as successful observability. Paraphrasing Quine: to be present is to be the value of a typed variable of a Level of Abstraction. It further provides reasons to distinguish between two types of presence, backward and forward. Finally, the new model is tested against two ethical issues whose nature has been modified by the development of digital information and communication technologies, namely pornography and privacy, and shown to be effective.

Artificial Intelligence and Philosophy: the case of Simon's AI project

Stefano Franchi

The intellectual and philosophical salience of Artificial Intelligence (AI) has a checkered and not well-understood history. Most practitioners consider it a technical disciple mostly aimed at the production of "smarter" artifacts. At best, the formal-computational methods used by AI or its specific theories of higher cognitive functions can be exported, and usually only to the most proximate disciplines (e.g. cognitive psychology, linguistics, etc.). Most often, the export is carried out within the protective umbrella of a naturalistic approach (along the classical lines of Quine 1959). In other words, skepticism for the high-minded ambitions of classical philosophy runs high, while the prevalent interest has been focused on specific collaborations at the level of particular theories of, say, perception, or concept-formation, etc. On the contrary, I will claim that research in AI, at least in its formative years (late 40s-early 60s) arose in a self-conscious opposition to the methods of classical philosophy, and turned toward the sciences in order find both a methodological canon and concrete tools for its analyses. At the same time, however, it accepted the traditional philosophical project of providing an exhaustive theory of human nature. Thus, AI did not construe itself as a purely technical discipline (in spite of its extremely successful marketing efforts in that direction); nor as the provider of a rigorous and potentially universal methodology for the social sciences; nor, finally, as the technically most advanced area of cognitive psychology. Rather, it saw itself as a "new philosophy" and indeed an *anti-philosophy* that aimed at recovering the goals and scope of the millennia-old attempts at an exhaustive account of man and his place in the cosmos, while replacing arm-chair speculations with a radically new kind of empirical approach.

The claim will be illustrated and defended with reference to the development of the work of Herbert Simon, from his early interest in von Neuman's work on game-theory (Simon 1949) and on chess (1951-52) to his later development and systematization of the notion of satisfacibility within the Artificial Intelligence paradigm (from 1956 on).

Towards a Functionalist Mereology for Artifacts

Pawel Garbacz

The paper contains a formal theory of the relation of the functional parthood. This mereological theory is based on the semi-formal ontology of artifacts. The ontological notion of situation (state of affairs) unifies the whole approach. It is argued that an adequate representation of an artifact consists of a representation of the artifact's purposes, a representation of its design, a representation of the background knowledge according to which it has been designed, and a representation of instructions of use relevant for that artifact. The paper mentions a number of theorems explicating various correlations among these representations. In particular, the social aspect of artifacts is highlighted. It turns out that the mereological structure of an artifact is determined by the functions of its parts. The definition of functional parthood leads to the minimal systems of functionalist mereology and to some of its extensions. It is explained why the principle of transitivity, the axiom of general sum, and the supplementation principles are false for the functional parthood.

On the Representational Role of the Environment and on the Cognitive Nature of Manipulations

Alberto Gatti and Lorenzo Magnani

The notion of *representation* is the focus of an important debate within cognitive science. The classical physical symbol system hypothesis argues that a cognitive agent entertains symbols and symbol structures arranged in a sort of *Language of Thought* with a combinatorial syntax and semantics. Any cognitive process takes place internally by means of the creation of an internal symbolic representation of the environment which is processed in order to generate an internal symbolic representation of an action to be actually performed.

A drastic reaction to this perspective is represented by Brooks's assumption that intelligence can go on "without representation", that is, without the necessary use of an internal, explicit and detailed representation of the environment. In other words, cognitive agents would use the environment as its own representation.

The core problem of our article is whether the environment can play a cognitive role as a representation that carries relevant information and whether human beings use a single representational code in their reasoning processes or they handle different kinds of representational code. Our hypothesis is that the environment can play the role of a representational configuration that carries information and, in particular, that the environment could be at the origin of the formal structure of the representations used internally by human cognitive agents. This is to say that we hypothesize that human beings use different representational codes whose formal structure is influenced by the structure of the environment.

The second point of our article is the relationship between external configurations that can count as representations and physical manipulations. We want to examine the hypothesis that physical manipulations can carry out the cognitive function of constructing external representations. In order to give support to such hypothesis we discuss examples in which manipulations of the environment create configurations that carry relevant information.

A challenge for further research is whether the hypothesis of multiple representational codes implies a rejection of the hypothesis of a *Language of Thought.*

Towards Meaning Processes in Computers from Peircean Semiotics

Antônio Gomes, Ricardo Gudwin, Charbel Niño El-Hani and João Queiroz

In this work, we propose a computational approach to the triadic model of semiosis (meaning processes), as stated by C.S. Peirce. His model of semiosis represents a key element in the construction of the next generation of artificial intelligence artifacts. These new and complex devices must be able to overcome current AI limitations, such as the symbol grounding problem. The contributions of the Peircean semiotics to the study of intelligent systems have not been systematically explored. In fact, most approaches in the literature adopt a naïve definition of semiosis, which usually plays a secondary role in the study. Our research, on the other hand, strives for a strong theoretical foundation for meaning processes, as well as its possible implementation within digital computers. We start by investigating theoretical constraints about the feasibility of simulated semiosis that can be derived from Peirce´s Philosophy. These constraints, which are basic requirements for the simulation of semiosis, refer to the synthesis of irreducible triadic relations (Sign – Object – Interpretant). We examine the internal organization of the triad, that is, the relative position of its elements and how they relate to each other by determinative relations. We then proceed by suggesting a multi-level (micro- and macro-semiosis) description of semiotic processes. In our view, the operation of these hierarchical levels may satisfy both theoretical constraints proposed earlier by means of some sort emergent behavior. In this context, relations of determination are described as emergent properties of the system. Nevertheless, the term 'emergence' is often used in a very informal way in the so called 'emergent' computation, without clear explanations and/or definitions. In this paper, we discuss in some detail the meaning of the theoretical terms 'emergence' and 'emergent properties' in the context of the implemented simulations, showing how such an analysis can lead to improvements of the algorithm proposed. In particular, a proposed explanation of how properties emerge in complex systems indicates the necessity of modifying the multi-level description of semiotic processes so as to include not two but three levels.

Alan Turing's Contributions to the Philosophy of Information

Gian Maria Greco

The paper seeks to contribute to the theoretical foundation of the Philosophy of Computation and Information (PI), through an investigation of its historical roots, via Turing's work. It is shown how the debate over the paradigm of PI may be solved through the recognition of Turing as the founding father of PI. The analysis is carried out in four steps. First, it is argued that PI, to be fully developed, needs to be grounded historically. This is because of the presence of a theoretical dichotomy in his paradigm. The debate between the computational and the informational aspects of PI birth produces a tension in the common understanding of his status, priorities and future development. Then, it is explained what were Turing's interests in information processing. It is recognized the use of data representation techniques, that are basilar in the contemporary information systems theories and computational methods. After, it is shown how these interests are related to Turing's work on machine learning and

game-playing computers. Particularly, it is underlined how data representation is the method grounding his researches on digital computers applied to game. Finally, it is pointed out how the new interpretation of Turing's contributions in information processing, together with its widely-recognized results in computing, may resolve the theoretical dichotomy.

A Very Big Adventure:
Using the internet to enable multi-institutional collaboration in teaching computer ethics

Joe Griffin

Teaching and learning in any subject can sometimes become mundane but in order that our students are motivated it is sometimes necessary to use an approach which makes the process *a very big adventure.* Over the past three years studies have taken place with students from the University of Limerick in Ireland and students from two other universities in England and the USA in the teaching of Professional Issues in Software Engineering (PISE) (Griffin, 2001, Griffin et al 2000a and 2000b). PISE focuses on the legal, ethical and social aspects of computing. The ethical strand of this module, which aims to develop moral reasoning in the learners, has in the author's experience often proved to be the most difficult for students to grasp and consequenlty has had a de-motivating effect on some learners. To deal with this situation the author decided to investigate methods by which students might be motivated and therefore gain more from their learning experiences and develop their moral reasoning abilities. The method adopted has been the use of virtual learning groups using internet based asynchronous communication tools to enable learners who would otherwise physically be unable to meet to come together in cyberspace and discuss moral issues relating to computer systems.

This paper describes two cycles of the study, the results obtained, lessons learned and a proposal for a multi-cultural approach to be used in future studies. Analysis of the development of moral reasoning by pre- and post testing students using Moral Judgment Test (MJT) (Lind, 2001) is provided. The results of this research will be of value for both academic and practitioners in the area of computer ethics and moral reasoning.

Problems with Simplicity and Analogy in the Theory of Explanatory Coherence

Marcello Guarini and Pierre Boulos

Paul Thagard has proposed a theory of explanatory reasoning in science that he calls the Theory of Explanatory Coherence (TEC). It integrates considerations of analogy, explanatory breadth, higher-order explanation, simplicity, and unity into one theory. In an attempt to gather evidence for this theory, Thagard constructed the computer program ECHO (Explanatory Coherence by Harmony Optimization). It takes as its input two competing theories and the known evidence; it provides as output a list of accepted propositions and a list of rejected propositions. Thagard has drawn from the history of science to construct representations of many episodes of theory conflict. ECHO (which implements TEC) can be assigned parameter values in such a way that when it is given these theory conflicts as inputs, it selects the appropriate theory as output: Copernicus' theory of the heavens is chosen over Ptolemy's, Newton's theory of motion is chosen over Descartes', Oxygen chemistry over Phlogiston, and so on. Thagard claims that ECHO's ability to get the right answers with respect to these theory conflicts provides evidence for TEC. We will argue that (a) the presentation of the role played by simplicity and analogy in TEC is ambiguous, and (b) once disambiguation takes place, underdetermination problems threaten the purported evidential link between ECHO and the different ways of interpreting TEC. TEC is biscriptive – it provides an adequate descriptive account of how scientists reason when they reason at their best. Thagard has claimed that TEC can provide us with prescriptive guidance. By using underdetermination arguments to question the strength of the support that ECHO can provide for TEC, our main aim is to question the extent to which ECHO and TEC can provide prescriptive guidance with respect to matters of simplicity and analogy in scientific reasoning.

Romanian Philosophy need to be «plugged» (on the Net)

Emilia Guliciuc

Analyzing the Internet's presence of the Romanian philosophy, one can observe that:

1. Accordingly to theirs contents or dimmensions, he Romanian cultural studies – especially the philosophical ones – that can be found on the Net nowadays, don't have the necessary consistence in order to be compared with those from other cultural spaces.

2. The national specificity is often understood and used as an excuse for the limitation to a particular *status quo*. Looking at the Romanian culture, someone can see the negativ aspects: only few Romanian philosophers can be reached from the Net, the famous Eliade, Cioran, Blaga,…; even those ones are not enough promoted etc.

The IT studies suggest that the use of the Internet technologies will grow in the next years as result of globalization.

The globalization is affecting more the western cultures that the eastern ones. (The reactions of the small cultures in order to promote their identity are more coherent).

It can be a chance for the small cultures, because it is affecting only the spreading of sub-cultures, because the distinctions between local and global are evanishing etc.

Improving the presence of national philosophies on the Net is an essential condition of their future development.

The creation of the philosophical websites can offer some clear advantages for the netizens, for the students and even for the academic staff or the researchers: a less time consuming navigation or searching for infos, a beter classifications of the infos etc.

In Romania, we have a lot to do, considering the fact that we have, nowadays only 4 philosophical e-reviews / e-journals and a projected philosophical e-encyclopedia. The real development of a network of Romanian philosophical e-spaces is still a dream.

Is Internet changing our language (s) ?

Viorel Guliciuc

The new communication technologies are definitely and sometimes dramatically changing our life-styles. That is why, anyone interested in the topics of semiotics & the sciences of language, *largo sensu*, can rhetolically put the question:

Do the relaxed standards of e-mails augur the end of literacy and spelling as we know it?.

Of course, there is nothing new about fears accompanying the emergence of a new communications technology. Asked if the usage of e-mail would impact on language creativity David Crystal stated that all domains of the Internet - e-mail, the Web, chat groups, and the fantasy games that people play - are introducing new styles and possibilities into the language: *"Every new technology does this. The arrival of printing brought an amazing range of new forms of expression. Broadcasting brought another. And now we have Internet technology, also adding a fresh dimension to language".*

Our aim is to explore the ways in which the nature of the electronic medium as such, along with the Internet's global scale and intensity of use, is having an effect on language in general.

"The electronic medium, presents us with a channel which facilitates and constrains our ability to communicate in ways that are fundamentally different from those found in other semiotic situations" (D. Crystal, 2001).

So, it is not surprisingly, that many of the expectations and practices which we associate with spoken and written language, no longer obtain.

The Case against PowerPoint in the Classroom

Lawrence M. Hinman

PowerPoint has become the most popular computer-based presentation software available, and it is playing an increasingly important role in education. Colleges and universities are spending millions of dollars to provide computer-equipped classrooms to facilitate its use. Building on the work of Edward Tufte and others, this paper argues that PowerPoint is bad computer-based technology. Two points are emphasized in this critique. First, PowerPoint impoverishes the information presented within it. Slides typically contain little information, whether text or graphics. The sequentiality of PowerPoint presentations exacerbates this problem, reducing learning to a screenful at a time. Bulleted lists often obscure complex and important relationships among the items of information being presented. Graphics, supposedly an integral part of such presentations, are typically static, generic and boring, but the pressure to use them can lead to the neglect of topics not easily visualized. Second, PowerPoint strikes at the very heart of the teaching process: the spontaneous interaction between teacher and student. Both students and teachers become passive, captive to the pace and structure of the computer-based presentation. Instead of looking at one another, they all look at the main inanimate object in the room: the screen. What should we do about this? The Luddite response—get rid of all technology—is examined and found wanting. Instead, we should respond on two fronts. First, the technology needs to be vastly improved, allowing for the much more finely-tuned presentation of knowledge. Specific ways of doing this are examined. Second, we must preserve and protect precisely the most important element in the classroom, the interaction between teacher and student.

Integrating Ethics and Technology

Deborah G. Johnson

I will describe a research program being undertaken at the University of Virginia with support from the National Science Foundation. The goal of the project is to illuminate the connections between technology and ethics by drawing on insights and theories from the field of science and technology studies as well as philosophy.

The starting place for the project is a re-conceptualization of technology. Technology is not (just) material objects; it is artifacts together with social relationships, social practices, social institutions and systems of knowledge. Artifacts are designed, produced, used, distributed, maintained and understood in the human world; they are inextricably intertwined with the social interactions of humans. Acknowledging technology as socio-technical systems has a variety of important implications and our research has begun to identify and understand these.

Decostructing the external/internal divide: The case of self-organising maps

Tarja Knuuttila and Timo Honkela

The objective of this paper is deconstructive in that we attempt to invert the hierarchy implicit in the internal/external divide. In Vygotskian manner, we ask whether the internal ”representation” is a product of our use of external representation and not vice versa. This line of thinking leads us to relativise the whole internal/external divide and open the notion of representation, which should be approached in material and processual terms.

>From the scientific practice point of view, the models in science can be considered as artefacts, materialized in some medium and having multiple epistemic uses.

Thus, even though they are typically constructed by representing some real entities or processes, models are often used in scientific practice without being considered as straightforward representations of anything.

Neural network models such as the self-organizing map, make a good example of this. Even though they have their origin in the analogy to the functioning of the human brain, perhaps most researchers developing them nowadays do not consider this analogy very relevant for their work. Therefore, it is commonplace to refer to similar methods as belonging, e.g., to the area of statistical machine learning. Yet, at the same time there is a heated debate going on in the cognitive science about the merits of ``connectionism" in explaining our cognition. There exists rather lot of neurophysiological evidence to support the idea that the self-organizing map can serve an abstract model of some of the fundamental adaptive processing principles of the brain. On the other hand, neural network models provide support for the idea that the mind need not work on internal representation as traditionally understood, but that it can be considered as a learning pattern matching device that works with the help of external artefacts—such as external representations.

Computer Science as a Subject Matter for Philosophy of Science

Peter Kühnlein

The interest of Philosophy in Computer Science is partial in two respects: first, only a part of Philosophy is interested, and second, the interest is in only part of Computer Science.

In the paper, I argue that strikingly Philosophy of Science has shown no interest in Computer Science until now. I argue that this is due to the fact that Computer Science indeed was uninteresting for any philosophical discipline that is interested in empirical sciences. In the past, Computer Science was mostly engaged in discussions about foundational questions, and hence has been a subject matter for Logic. And the methods developed by computer scientists have been of interest for philosophers of mind, as they could be taken as models for deep questions concerning the working of cognition. But Computer Science today has changed and especially its applied parts are intimately interwoven with empirical sciences. In the present paper, this is exemplified by the development of multi-modal integration (MMI) in the field of human-computer interfaces (HCI).

In this area of Informatics, computer scientists heavily rely on findings from, e.g., Psychology or Psycholinguistics. That means that the algorithms that are implemented no longer are shaped purely by demands of logical correctness or complexity considerations. What is new is that empirical results influence the implementations. An example is described from the field of speech-gesture integration that shows how closely the disciplines are interrelated.

What is an advantage on the one hand (in terms of ``naturalness" of interfaces) is a danger on the other hand. Wrong interpretations of empirical findings pose a threat to the development of computer programs if the rely on them. An example is given where empirical findings obviously are contradictory so that implementing one of either does not guarantee a natural HCI.

It is concluded that, given the interrelation between empirical sciences and Computer Science, there should be a genuine interest in Computer Science from the side of Philosophy of Science. Furthermore, good implementations of HCI are argued to be good candidates for aids in deciding deep questions in Philosophy: Turing's Test is here taken as an example, without going into details of the right interpretation of Turing's own interests in the test.

Why there cannot be a complete science of enquiry

Brendan Larvor

Formal learning theory has developed as a mathematical model of language-learning and, latterly, of scientific enquiry. It is able to model some but not all of our methodological maxims. Specifically, there are methodological notions and truisms that require some reference to the specifics of the domain of enquiry or the unity of the enquiry itself. The unity of these complex wholes (domains of enquiry and research programmes) resists formalisation, because each whole has its own unifying principles. Consequently there can never be a general mathematical model of enquiry, though the partial models now available are insightful.

Computable and Non-computable Procedures in Turing's Theory of Mind

Jean Lassègue

Turing's theory of Mind has been wrongly interpreted in a formalist way, i.e. exclusively computable and deterministic. That is why his 'Imitation Game' described in (Turing 1950) was wrongly called a test (the 'Turing Test') which would show, on a statistical basis, that the discrimination between the verbal expressions of a human being and those of a computer lies beyond human decision.. This interpretation rests upon the results collected during the classical (18^{th} – 20^{th} century) period of the determinist paradigm, which was already out of date in Turing times, especially after the works of Poincaré in physics and Gödel in logic. Indeed, Turing made a great contribution to the classical paradigm by implementing an absolutely deterministic artefact in the material world – the computer – which could therefore be akin to a certain class of material objects (whose classical examples are simple pendulums and pulsars). But Turing was perfectly aware that absolute determinism was not the ultimate paradigm of scientific explanation, as it is shown explicitly in (Turing 1950). That is why Turing's main object of research throughout his intellectual life was precisely the transformation of absolute determinism into relative determinism, which implies to reconsider the relationship between computable and non-computable procedures. Focusing my attention on the 'imitation game', I give some clues to interpret Turing's theory of Mind in a non formalist way by showing that what is at stake in this relationship between the computable and the non-computable is not only deep problems in formal axiomatics but also the causal construction of biological forms as well as the emergence of meaning in a theory of culture.

>From the Middle Age to Multimedia: How Ramon Llull's Ars Magna can be Revived on the Computer

Thessa Lindof

In this article the author tries to explain, how Llull's Ars Magna works, what is special about it, and how it can be translated on to the computer. Finally, the author tries to show, what possible use we can have from the Ars in our lives today.

Ramon Llull was a Franciscan lay-monk, who lived and worked during the 13^{th} century. He travelled around the Mediterranean countries, trying to convert non-christians to Christianity

The Ars Magna was conceived by Llull after his conversion to a truly Christian life. Having no theological education, he was not allowed to teach Christianity by using the bible. Instead he developed the Ars. With this he wanted to facilitate crosscultural communication between Jews, Christians, and Moslems. Llull founded the Ars Magna on nine basic principles, which he found by looking at the similarities in the three abovementioned religions. With these principles and rules for combining them he developed a system, which made argumentation among the followers of the three religions possible, thereby showing that argumentation instead of violence and war was possible when trying to find religious truth. In fact Llulls Art as primitive as it may seem to us today was and is one of the most complete and thorough systems in the history of language formalisation.

Looking at the world today, Llulls system is starting to make sense again: Being a formalised system, it is relatively easy to translate to any computer language (the author used Prolog and Director for the task). The task is to make it work together with the challenges placed to us by the fighting, which is going on in different parts of the world. Here the Internet is meant to play a main role in the development of an art of discussion based on Llulls Ars Magna.

Computer Imitation and Mathematical Understanding

Giuseppe Longo

>From the physico-mathematical view point, the imitation game between man and machine, proposed by Turing in 1950, is a game between a discrete and a continuous system. Turing stresses several times the laplacian nature of his discrete-state machine, yet he tries to show the undetectability of a functional imitation, by his machine, of a system (the brain) that, in his words, is not a discrete-state machine, as it is sensitive to limit conditions. We shortly compare this tentative imitation with Turing.s mathematical modeling of morphogenesis (his 1952 paper, focusing on continuous systems which are sensitive to initial conditions).

On the grounds of recent knowledge about dynamical systems, we show the detectability of a Turing Machine from many dynamical processes. Turing.s hinted distinction between imitation and modeling is developed, jointly to a discussion on the repeatability of computational processes. The point is that, in our views, causal relations are structures of intelligibility: they participate to the human organization of natural phenomena and make them intelligible. We establish these relations after some friction with certain regularities of reality (those which we "see"), which in turn canalize our cognitive action. Mathematics are at the heart of this construction of knowledge and, particularly, the choice of continuous or discrete mathematics has marked in a constitutive manner the history of our relationship to the world. I shall attempt to explore, as framework to the questioning laid, in which sense this choice proposes different structures of the causal relations.

From theoretical and empirical constraints to synthetic experiments on symbol-based communication

Angelo Loula, Ricardo Gudwin and João Queiroz

Artificial Life, Animats, and Synthetic Ethology are some of the interdisciplinary areas of research involved in the synthetic design of cognitive systems and creatures. These areas have been designing environments that work as experimental labs, where it is possible to test the predictions derived from theoretical models. They are based, many times, on different computational tools, and have various pretenses. But they are heavily influenced by meta-principles (*formal theoretical constraints*) and, a lot of times, by biological motivations (*empirical constraints*), in the design of the environment and the morphological definitions of sensors, effectors, cognitive architecture and processes of the conceived creatures. This means, in practice, that the set of constraints and motivations inform the scientist: What does he want to simulate? What needs to be considered? How can he know if the result is a good simulation?

We present a synthetic experiment for the study of a high-level cognitive process – symbol emergence and grounding – involving communicative interactions between artificial creatures. The set out, design and synthesis of our creatures, along with the digital ecosystem, were constrained by semiotic meta-principles and biological motivations from an ethological case. We propose, based on Peircean semiotics and informed by neuroethological constraints, a methodology to simulate the emergence of *symbolic* predator-warning communication among artificial creatures in a virtual world of predatory events. In order to build a digital ecosystem, and infer the minimum organizational constraints for the design of our creatures, we examined the well-studied case of semiosis in East African vervet monkeys (*Cercopithecus aethiops*) and their possible neuroanatomical substrates.

Revealing colours

Ludovica Lumer, Luca De Carli, Davide Gadia and Daniele Marini

Images acquired by capture devices often show chromatic shifts when compared to the original scene. Within the image reproduction pipeline, display devices, such as monitors and print media, limit the maximum dynamic range opening up problems of accurate reproduction of the luminance dynamics and colour distribution. In creating algorithms to interpret and reproduce image data we confront the same challenges as the visual system and to improve the performances of our computational model, derived by Edwin Land's Retinex theory of human vision, we found very useful to emulate the same kind of neural transformations undertaken by the human visual brain. We have tested our algorithms on a number of test scenes and all results have shown that the computational method improve greatly its performances when based on the same kind of neural transformations as the human visual system, but it remains open the main question of how to judge the quality of our results, namely how to judge the quality of the filtered photograph when compared with the original scene. Perception is in fact an interpretation of the retinal image. The retinal image is always different and often ambiguous, the brain has to extract constant features in order to be able to recognize the world, and compare the selected information with its stored record of all that it has seen. Judging image quality is therefore a complex task. It is a task of visual perception and aesthetic judgment. We are still far from knowing the neural basis of the laws that dictate appreciation but advances in brain studies allow us to make a beginning in trying to formulate neural laws of quality appreciation.

Abduction and its distinctions

Lorenzo Magnani

The recent epistemological and cognitive studies concentrate on the concept of *abduction*, as a means to originate and refine new ideas. Traditional cognitive science and computational accounts concerning abduction aim to illustrate discovery and creativity processes in terms of theoretical and "internal" aspects, by means of computational simulations and/or abstract cognitive models, that is in termns of what I called *sentential* and *model-based* abduction. A neglected issue, worth of a deepest investigation inside artificial intelligence (AI) and cognitive science, is that "discovery" and hypotheses generation is often related to a complex cognitive task involving the use and the manipulation of external world. I will illustrate in this presentation another important kind of abductive reasoning where concrete manipulations of the external world constitute a fundamental passage in discovery processes: by a process of *manipulative abduction* it is possible to build prostheses (epistemic mediators) for human minds, by interacting with external objects and representations in a constructive way. This kind of embodied and unexpressed knowledge holds a key role in the subsequent processes of scientific comprehension and discovery. In will describe some of the "templates" of manipulative behavior which account for the most common cognitive and epistemic acting related to discovery processes in scientific reasoning.

Moral mediators in a technological world

Lorenzo Magnani

Modern technology has made nature an object of human responsibility with the consequence that we must approach her not only with cleverness but also with ethics. The idea of moral knowledge as something simple and readily available to all men of good will is not sufficient anymore. Contrary to Kant, who maintained that "there is not need of science or philosophy for knowing what man has to do in order to be honest and good, and indeed to be wise and virtuous", ethics and decision making behavior should be continually and carefully accompanied by knowledge related to an understanding of the various problems and situations. The "neighbor ethics" of justice, charity, honesty, etc., is not sufficient anymore, because this local sphere of ethical action is overcome by the domain of collective action where effects are frequently not, from both spatial and temporal point of view, in a proximate sphere. I contend that new tasks of human behavior require the assumption of a long range responsibility, coextensive with the range of our power. If we want knowledge (both scientific and ethical) to be considered as a duty in the perspective of a supernational knowledge society, the aim should be on the generation, distribution, and use of knowledge in favor of economic and social development. If knowledge has to be considered a duty the problem of its dissemination and distribution is central. O will introduce some transdisciplinary issues related to this problem: from the need of promoting the study of creativity and model-based and manipulative thinking in scientific and ethical reasoning and knowledge to the role of some external cognitive structures I call “moral mediators”, that are able to reshape ethical worth of human beings and collectives in our technological world; from the interplay between unexpressed and super-expressed knowledge and knowledge management and their role in the information technology to the problem of the nature of the mechanisms for forming interesting rational ethical argumentations.

Computing or Dynamics: Does it Matter For a Theory of Mind?

Mathieu Magnaudet

The dynamical hypothesis in cognitive science is often described as a radically new paradigm. Supporters of this hypothesis propose to leave the computer metaphor and to build a new theory of mind based on dynamical systems theory. Here we want to stress that a criticism of the computational hypothesis is not necessarily to offer a new theory of mind. In classical cognitivism, the computational hypothesis is just a part of a more general framework. Here we propose to explore the computational hypothesis, its content and its philosophical justi-fications, and to present some requirements that dynamicism must satisfy in order to be a real alternative theory of mind. Roughly speaking, the computational hypothesis is the claim that some material object having cognitive properties is adequately described by a formal system which belongs to the class of computational systems. So, we propose to define the concept of computational system and to clarify the implementation relation. Then we expose philosophical reasons given by Fodor to appeal to a computational hypothesis. Finally, we maintain that there are two ways to be a dynamicist. The first one is just a refinement of cognitivism. It consists to accept a fodorian like theory of intentionality, that is the reduction of intentionality to mental representation and the acknowledgement af the importance of mental representation to explain behavior, but to propose a new dynamical theory of mental causation. The second one is the rejection of classical analysis of intentionality and mental representation. The latter is the only way to go toward a new paradigm but we still have very few ideas about what it could be.

Representation and computation in the understanding of conditionals

Andrea Manfrinati, Paolo Cherubini and Pierdaniele Giaretta

There are at least three open questions about the understanding of conditionals. The first problem is that there seem to be many primitive notions of conditional that have in common only the case of falsity (i.e., antecedent true and consequent false); the second is the neglected relation between a conditional affirmation and the affirmation of a conditional; the third concerns the possible presence in the human mind of notions of conditional which are not completely determined. In this paper we start from what understanding of conditionals is taken to be by the theory of mental models. We point out some ambiguities and theoretical limits of this theory, with the purpose of providing some ideas and some hypotheses for a new conception of conditionals which might have an relevant role in the cognitive explanations.

According to the theory of mental models the model for a conditional like “if *p* then *q*” is the following:

p q
...

where the three dots (ellipsis) represent the other possibilities consistent with the truth of the conditional, that aren’t explicitly represented. Johnson-Laird’s idea that the conditional is taken to say nothing about a situation respect to which the antecedent is false seems to suggest, in particular, that when the antecedent is represented as false, the conditional is taken to lack a truth value. It follows that if the conditional is considered as lacking a truth value in the cases where the antecedent is false, it seems senseless to assume that a mental note is made in order to point out the presence of implicit models (consistent with

conditional) which are irrelevant for the evaluation of the conditional. If we reject the idea that people have an implicit knowledge of the completely defined notion of conditional suggested by the characterization of the corresponding logical connective by means of the well known truth table, we might think that they have a different incomplete notion of conditional. But there are also some data which seem to be compatible with the hypothesis that the cognitively relevant notion of conditional is such that it is false when - or in some cases where - the antecedent is false.

Further questions arise by taking into account the conditional from a computational point of view. First, computational processing of the conditional seems to presuppose a totally defined notion of it. To what extend is it so? Second, do systematic mistakes in tasks concerning conditionals manifest a computational failure or depend on other causes, including a different interpretation of the conditional? Third, taking for granted that it makes sense to speak of logical competence and that one or more notions of conditional belong to it, which kind of basic computational mechanisms does rule conditionals in thinking and inferring?

The Interactive Learning Environments Made on a System Dynamics Basis

Stanislava Mildeová

The goal of this paper is to contribute to the topic of interactive learning environment for systemic thinking and dynamic intuition support – the development of system understanding and students' „dynamic intuition" – prospective managers and the possibilities of its computer support.

We discuss the possibility of overcoming the drawbacks given by the characteristics of people's mental models on the basis of systemic dynamics, which uses explicit modelling by computer simulations.

The author presents system dynamics management flight simulators, systemic dynamic managerial simulators as a tool that allows enhancing of our mental models; as „learning labs", allowing description of the system dynamic behavior including the circular feedback structures

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Ifa Divination and Computer Science: A case of African Tradition.

Theophilus Otselu Ogbhemhe and Theophilus Imafidon Obaseki

In the paper, we try to answer a possible question, " What is Computer Science and information technology?". This is followed by a brief account of some progressive developments of the digital computer as well as in the area of information technology. We shall then elaborate on some basic concepts of Computer Science and Information Technology. Similarly, we shall try to answer another possible question, "what is Ifa Divination?" This will be followed by a brief description of the techniques of divination and the basic structure of If a Divination poems. We shall then illustrate some of the remarkable similarities between Ifa Divination and Computer Science. Finally, we shall make a case for Africa (and Nigeria) as a continent that has contributed to the field of Computer Science and Information Communication Technology, the disparaging notion held about her notwithstanding.

Intellectual Techniques, Information Technologies and Cultural Models for the Knowledge Society

Laura Pana

Information activities and information technologies generate an information environment in which intellectual invention is facilitated by new intellectual techniques, imposed by the actual technical culture. In the philosophical domain of activity, always were used intellectual techniques constituting its technical infrastructure, which is now renewed or changed with the computing techniques. These permit the perception of information in its various forms, show new resources of scientific cognition as the genuine or, on the contrary, high elaborated forms of nonverbal human reasoning, offer new instruments for analysis or for ideal experiments, for modelling and simulation of theoretical constructs.

Other techniques represent unprecedented means for finding, processing, structuring and transmitting new knowledge: integral representation of the "map" of a net of knowledge, recording and revival of achieved links, help to place "reading marks", use of intelligent agents or even multi-agent systems or direct links on WWW for the interrogation of the informatic environment, utilization of hypertext and e-activities in group or at distance for the philosophical community.

Interdisciplinary research of the new social structures imposed by the development of the information technologies indicate that actual sociotechnical systems evolve to a knowledge society. We propose a study of cultural models which can describe some foreseeable traits and trends of this society. We analyse also the possibility of transition from the information and then from knowledge society to the culture society. As we can see now, and as we can foresee, the information and knowledge based societies can not support a developed integral cultural system.

The durable development of the information technologies will be extended and fulfilled, in all human activities, probably, by intellectual technologies. In our paper, we develop and analyse conceptual models of the structure and tendencies of the value-systems in the future knowledge society. We study also the possible coherence of actual Romanian values hierarchy with the European cultural model and its probable changes by the influence of the developing technical values.

Mechanisms and Simulations

Gianluca Paronitti

The paper seeks to provide a criterion to identify which systems qualify as mechanisms. In order to understand this criterion three steps are required: the first step is to introduce the method of Levels of Abstraction (LoA) [Floridi and Sanders, 2003a] that is a method to analyse the phenomenological and conceptual outcome of agents' interactions with their environment. The second step is to explain simulation relation that is a specific kind of relation between the observables of two LoAs. The last step is to utilize this relation between LoAs to discriminate which descriptions characterise a system as a mechanism.

The criterion depends on the simulation relations within the set of Levels of Abstraction (LoA), constructed to describe a system. Agents interact with their environment through LoAs and by their means extract information about the systems they are observing. The criterion is based on the analysis of the simulations used by agents to confront and evaluate LoAs. It states that if all the LoAs used to produce information about a system are in a simulation relation and their transition rule is explicit then the system is a mechanism.

The first part of the paper briefly introduces the current discussion about the concept of mechanism. It is explained why it is epistemologically relevant to have a precise account of mechanisms, and then a general filter is suggested to understand most of the current definitions of mechanism.

There follows an explanation of what a Level of Abstraction is and of which type of relation among LoAs is a simulation.

The central part of the paper explains the criterion of identification and its epistemological connection with the common understanding of mechanism.

In the conclusion, (a) it is discussed what the criterion means within the discussion on mechanism with special reference to the Humean speculation (in particular, it is suggested that this criterion is a further specification of the Hume account of causality and not an attempt to abandon this view); and (b) an argument is proposed that connects the criterion with functionalism (in particular, it is argued that the realizations, that typically characterise a functional explanation, conform to the criterion and therefore should have mechanical descriptions).

Semiosis in Cognitive Systems: A Neural Network Approach to the Problem of Meaning

Eliano Pessa and Graziano Terenzi

In this paper we deal with the problem of understanding **semiosis** and **meaning** in cognitive systems. To this regard we argue for a unified **two-factor account** according to which both external and internal information are two non-independent aspects of **meaning**, thus contributing as a whole in determining its nature. However, if considered on purely philosophical grounds, two-factor accounts suffer from a number of difficulties, including the problem of **relativism** and the so called **alignment problem**. In order to overcome these difficulties we put forward a theoretical scheme, which is based on the definition of a suitable **representation space** endowed with a set of **transformations**, and we tried to show how it can be implemented by a **neural network** architecture. Numerical experiments done on the model showed a strong dependence of performance both on the structure of the representation space and on the functional couplings between the process of **symbol categorization** and the process of internal **symbol transformation**. Moreover, a comparative analysis carried out on different instances of this same architecture showed that, notwithstanding their differences, similar representations are developed as a consequence of the fact that they are facing a similar semantic task.

Serendypian and non-serendypian abduction

Claudio Pizzi and Duccio Pianigiani

The distinction between serendypian and non-serendypian abduction will be outlined by showing that such categories are appliable not only in scientific inquiry but in other fields such as legal investigation. Taking for granted the creative dimension of abduction, emphasis will be given to the ways in which logic, and especially modal logic, is able to enlighten the rational structure of such inferential processes. In particular, modal logic allows to make clear the distinction between causal and non-causal explanation, so between causal and non-causal abduction. In this connection it may be shown that problems which are inherent to counterfactual theories of causation cannot be neglected in the realm of abducttive reasoning.

Intentionality and Moral Agency in Computers

Thomas M. Powers

According to 20th Century philosophy of mind, intentionality is "aboutness": the property of a process, state or entity such that it is directed at or represents an object or state of affairs in the world. On the view of Fodor (2000) and others who hold the computational theory of mind (CTM), "intentional processes are syntactic operations defined on mental representations." Implicit in the works of much of CTM is the view that human cognition is essentially representational, and so computer representations allow a plausible mapping of cognition, including intentional processes, to computation. In Fodor's words, the CTM holds that many (if not all) of our cognitive processes are essentially "structured mental representations that are much like sentences." The "language of thought" is replicable, in principle, in the language of computer software. This comparison of thinking (by means of intentional states) to computing (by means of representations) allows us to see the logical state changes of a computer as similar to state changes in the human mind. With slight variations, these views are shared by Putnam, Dennet, Pylyshyn, and many philosophers working in cognitive science (McClintock, 1995).

Can tacit knowledge fit into a computer model of scientific cognitive processes? The case of biotechnology

Andrea Pozzali

Modern information and communication technology has surely produced a great influence on philosophy. This influence is twofold: on one side, this technology has changed the way in which philosophers work, introducing them to the use of tools such as computers, e-mail, virtual libraries and, last but not least, the Internet and its huge amount of information. On the other side, information and communication technology has provided philosophers with a whole new set of problems and issues to reflect upon and has contributed to the rising of new streams of philosophical research.

The growing enthusiasm surrounding this "computational turn in philosophy" should not lead us to think that the diffusion of information and communication technologies will have only positive effects on the activities of philosophers, anyway. As Gert-Jan Lokhorst pointed out in his review of *The Digital Phoenix* (1999), this diffusion can have also negative effects, for instance by breeding a certain degree of conformity and by hampering human creativity.

The aim of this paper is not to explore the consequences of the diffusion of computer on human creativity, indeed. Rather, I will try to express a critical point of view on the computational turn in philosophy by looking at a specific field of study: philosophy of science. The paper start by briefly discussing the main contributions that information and communication technology has given to the rising of computational philosophy of science, and in particular to the cognitive modelling approach. Then I will try to analyse how computational models can cope with the presence of tacit knowledge in science. How can we try to represent the process of scientific knowledge development in a computational model, if this process is influenced by tacit knowledge, that cannot be easily codified or formalized? Would it be possible to develop new ways of handling this specific type of knowledge, in order to incorporate it in computational models of scientific thinking? Or should tacit knowledge lead us to other approaches in using computer sciences to model scientific cognition?

Is a Closed-Loop Discovery System Feasible?

Alexander Riegler

Empirical equation discovery of quantitative laws has been successful in many domains. However, mechanical number crunching of sophisticated data-mining algorithms cannot answer the question what it takes to create artifacts that properly *represent* and *understand* a certain insight. As a first step it has been proposed to shortcut the gap between system input and output which is usually occupied by humans, i.e., to design *closed-loop systems* that not only generate and select hypotheses, but also carry out the necessary experiments. However, since there is a practically infinite number of ways to extract a (qualitative) law from a given data set and since cognitive research shows that perception is controlled by the cognitive apparatus rather than determined by the stimulus, I make two proposals. Firstly, the direction of information-processing should be reversed, i.e., artifacts project a priori created 'mental structures' structures onto 'external' sensorimotor experiences rather than (algorithmically) compress the flood of sensory data. Because "things don't come labeled", the cognitive apparatus does not work on propositions but rather uses a semi-neuronal production system allowing for mental scaffolds of the most abstract form. Secondly, in order to escape arbitrary constructions we assume that the formal properties of these scaffolds induce certain interdependencies. Consequently, the apparent cognitive limitations of the human mind are but an expression of its canalizations (rather than an obstruction), which enable reasoning in the first place. Both *projective constructivism* and *cognitive canalization* make artificial closed-loop discovery systems feasible in the sense that they reduce computational requirements and enable embeddedness in the respective domain of reasoning.

Category Learning by Formation of Regions in Conceptual Spaces

Jaakko Särelä, Jan-Hendrik Schleimer, Mikko Berg, and Timo Honkela

In this paper, we discuss the issue of conceptualization. The traditional view is that concepts are essentially linguistic. Recently, Gärdenfors has proposed a contradicting view where the concepts get associated to language terms, but essentially belong into other domain called conceptual spaces de_ned by quality dimensions. These dimensions form meaningful representations of the concept domains in hand and they should be formable by mappings from the sensory input and possibly from other more basic quality dimensions as well. Often Gärdenfors takes the quality dimensions as given. However, only some of the dimensions can be innate, and others should be learned. One natural framework for the learning of the quality dimensions is provided by the connectionist approach. Still, the principles guiding the learning are not easy to state as they should include at least, capacity constraints, generalisation properties and _nally, the relevance of di_erent structures in the sensory data for the particular task the concepts are needed for. In the space spanned by the quality dimensions, natural concepts form convex regions. The borders of these regions can be hard or soft and can vary according to the context. In the present work, we have decided to code the regions by prototypes, so that instances closest to a particular prototype in the conceptual space form a region. In other words, the regions are de_ned by the Voronoi tessallations of the prototypes, which then de_ne hard bordered regions. In the case of soft borders, the prototypes can consist of probabilistic density functions de_ning graded membership function for each point in the conceptual space. In this paper, we mainly discuss the formation of the regions of concepts via di_erent kinds of clustering approaches. Some discussion of the connections to the lower, connectionist level and to the higher, symbolic level are discussed in brief.

A Relational Stance in the Philosophy of Artificial Intelligence

Colin T. Schmidt

When it comes to speaking about communication, I treat the sciences of the artificial, for example Artificial Intelligence, Human-Computer Interaction, Robotics etc., as one block. It is quite obvious that sociological and philosophical descriptions of the way inter-human communication works does not fit situations in which artificial components interact with natural ones (people). But why is this? Do any of the participants at this conference have a formalised opinion on this matter? Will a demonstration of this one day be possible? Perhaps the lack of responses to this last question is the reason why the scientist of the artificial persist in using and reusing models of interpersonal communication for situations having nothing to do with the social mechanisms supporting conversation, negotiation, referential dialogue or other discursive strategies humans enjoy deploying.

The old debate about *reference* has struck back because people nowadays wish to socialise by communicating *through* technical objects. Artificial Intelligence is commonly used to represent the Other at the interface. This article expresses a realistic logic about the notion of *non-persons* that should be applied in designing technically evocative objects and thus human-machine encounters in the future (this is not currently the case). Such a Logic is justified by the difficulties people are experiencing at the material level of communication. Realising the need for clearly stated Logic in this area is a step forward for all disciplines of the artificial.

Connectionism Meets the Language of Thought

Paul Schweizer

For a number of years now there has been a high-profile struggle between opposing paradigms within the computational approach to the mind. The classical paradigm derives from Turing's basic model of computation as rule governed operations on formal symbols. This paradigm has taken perhaps its most literal expression in terms of Fodor's Language of Thought (LOT) hypothesis, wherein high level cognitive processes are viewed as rule governed transformations on a linguistically structured system of internal symbols. In contrast, connectionist systems are based on networks of large numbers of simple but highly interconnected units that are brain-like in inspiration. According to Fodor, it's perfectly possible that the non-representational neurological states of the brain are connectionist while the representational states of the mind are not, because (i) it's possible to implement a classical cognitive architecture within a connectionist neural network. On the positive front, Fodor supplies arguments to support the notion that the mind really does have the shape that the LOT assigns it. Fodor cites (ii) the productivity and systematicity of thought as prime examples. In turn, other arguments are negative, and try to undermine his opponents by contending that connectionist networks are too impoverished to yield several key features that characterize the mental level. For example, Fodor claims that (iii) connectionist networks are unable to yield the systematic and productive linguistic capacities essential to the mental level of description. First I examine Fodor's key negative claim (iii) and argue that if it were true, then it would form an inconsistent triad with (i) and (ii), which makes his overall position untenable in principle. Next I look at the evidence for Fodor's positive claims and argue that it is too weak to yield the necessary support for a LOT.

Then I argue that in this respect the same problem afflicts the opposing views. My conclusion is that both parties to the dispute attach an overly literal interpretation to their favorite brands of computation, and this is encouraged by an equivocal reading of the term 'model'. Computational models are treated as if they're structural descriptions when this is far too strong. At

this stage we should resist the temptation to inwardly project abstract frameworks that yield a small set of salient input/output results. Computational methods, both classical and connectionist, supply models in a simulational/instrumental sense, rather than literal descriptions of cognitive processing structure.

Computation and Observation: metaphysical implications of executions

Ken Shiotani

We try to do analysis of “Dasein” of computation. To do so, we change our metaphysical standpoints from usual, state-based one to function/move-based one. We see computation as some fixation between inputs-outputs called I/O-link. In this setting we analyze computation as function. In parallel consideration on another function called observation/experiment as different aspect of I/O-link, we see some duality between computation and observation/experiment. Without presupposition of existence of some real process, notion of execution becomes to denote interaction of these dual functions. To characterize execution as interaction, we think about possibility of concatenation or division of I/O-link. As consequence we see contents and existence of combined I/O-link depend on this interaction, and we suggest that there is new level of execution so called differential-execution, possibility of diversity of integration for this level. We can see the analogy between computation-observation/experiment-execution and syntax-semantics-judgement. We extend this interaction toward outside of a computation as a whole, and get the notion of scheme as formality of computation. With this notion we think one selected possibility of integration of differential-execution as code of computation and there is some room for tacit commitment of our regulation.

The frame problem and the treatment of prediction

Mark Sprevak

Several philosophers have suggested that the frame problem in artificial intelligence is indicative of new and interesting problems in epistemology. However, there has been much disagreement both about what the frame problem is, and how it is relevant to epistemology. This paper argues for a relatively modest but precise way in which the frame problem is relevant to epistemology. The frame problem is relevant in at least the following sense: it provides a precise way of discriminating commonsense reasoning from prediction using a scientific theory. Of course, many people already believe that these two forms of reasoning are distinct. However, certain approaches have tended to assimilate the two forms of reasoning, and even for those who believe that the two forms of reasoning are distinct it has proved remarkably difficult to say exactly where the difference lies, and why it matters. I argue that the frame problem can help. This structure of the paper is as follows: (1) An account of the frame problem is given; (2) The frame problem is distinguished from related problems; (3) The main strategies for dealing with the frame problem are outlined; (4) A difference between commonsense reasoning and predication using a scientific theory is argued for; (5) Some implications for the computational theory of mind are discussed.

Rationalism versus Empiricism: A New Perspective

A.M. Stepak

Chomskyans claim that grammatical structure is learned in prestructured blocks, intuitively, that could not be explained by an empirical learning of the component parts comprising of the structure. Further, Chomskyans claim that the grammatical structure of language is not a logical representation of components parts that could be learned.in other words, that the grammatical structure itself, acquired intuitively, is irreducible. Relying on new concepts I have introduced, .Oral Metaphor Construct. (OMC) and .Knowledge Inheritance. and basic principles in Information Theory, I will argue that the visible generative grammatical structure of language is not what is actually learned but ,rather, represents a pattern (fractal) of more fundamental learning that is .cognitively linear. In other words, what is actually learned could be described in terms of its component parts, thus, supporting the empiricist notion of a non-domain specific cognitive mechanism governing language use and refuting the Chomskyan viewpoint.

Unifying Approaches to the Unity of Consciousness

Susan Stuart

Whole landscapes of thought and literature have been devoted to defining what is meant by the unity of consciousness, asking questions like who or what is doing the unifying and what is it that is being unified. In this current paper I will attempt to draw together two singularly different approaches to the problem with the intention of edging the debate a little closer to a resolution. The first approach to be examined will be Cotterill's (1995) wherein he argues that consciousness is primarily associated with movement and response, and that the necessary co-ordination of movement and response requires a unity of conscious experience. The second approach to be examined is Kant's (1929) critical philosophy and, in particular, the claims he makes for the transcendental unity of apperception and the role of the cognitive imagination. Cotterill's argument focuses on a

neurophysiological approach to the problem and identifies the anterior cingulate as the 'site' of consciousness. Kant's approach is metaphysical, focusing on describing the logically necessary prerequirements for a unity of consciousness with the power of the cognitive imagination playing a central role because, I will argue, Kant is committed to an active, sensorimotorily enmeshed view of consciousness. In accepting Kant's metaphysics as prescriptive of the requirements for conscious human experience, the kind that requires a unified subject of experience, we can examine how Kant's functionalist (Sellers 1970; Brook 1994) claims might be reinterpreted, recognised and possibly even realised within the framework of contemporary neurophysiology and robotics.

"It's a wonderful model" An investigation into the notion of an "algorithmic explanation" and its computational limits

Chiara Tabet

This paper aims at investigating what looks like a fundamental ambiguity in the notion of an "algorithmic explanation" in cognitive sciences. Such an ambiguity first of all concerns the unclear epistemological status of the (algorithmic) tools that such an explanation makes use of. It thus concerns the way in which we can account for the nature and behaviour of "algorithmical structures" that are central tools in the construction of an explicative scientific model. The attempt of producing what we may call a "self-reflexive", or self-transparent epistemology of algorithmical explanations seems, however, to meet difficulties which are directly linked with the logical indeterminacy which is necessarily at stake when we try to apply self-referential patterns at an intensional level. The ambiguity also concerns the ontological status of algorithms as procedures for meaning-attribution, that is: for organization and selection of (thus) meaningful information. In the treatment of problems linked with the latter question, it will also emerge why I am here speaking about an ambiguity rather than of a mere difficulty. This has to do with the fact that it does not seem that we can properly speak of "explicative" algorithmically based models, but rather of descriptive and/or heuristical models.In discussing about the ontological problems raised by some methodological version of an algorithmic explanation, attention shall also be paid to their interdependencies with (difficulties found at) the epistemological level, as well as to some difficulties faced by a realistic ontology of intensional-algorithmical structures. Among these, the problem of establishing an epistemologically sound link between intensional logical structures and environmental (physical and causal) conditions will be especially investigated.

The Ins and Outs of Mental Properties

Allard Tamminga

Logical behaviorism was first conceived by the members of the Vienna Circle. Its proponents claimed that every cognitively significant psychological sentence p could be translated into a physicalistic sentence q, such that p and q are empirically equivalent. Nowadays, in (Dennett, 1987), it is argued that there are only pragmatic reasons for introducing mental properties, such as beliefs, desires and intentions, into descriptions of agent behaviour. Logical research, based on a conceptual apparatus derived from artifical intelligence (Jonker and Treur, 2003), shall be used to critically evaluate Dennett's argumentation on the use of introducing mental properties in theories about behaviour.

We shall reserve possibly indexed ? s to denote observable circumstances, possibly indexed ? s to denote an agent's mental properties, and possibly indexed ? s to denote the agent's observable behaviour. So, a formula of the form "? ? ?a,b?? " expresses that at a certain time-point in an interval (a,b) after a time-point where circumstances ? were observed, the mental property ? will be true of the agent.

A *behaviour description* for a pair (M,T), where M is a set of time-indexed sequences of states and T a time-frame, is a set BD of implicational formulas of the forms "? ? ?a,b?? ", "? $_1$? ?a,b?? $_2$", "? ? ? $_1$? ?a,b?? $_2$", "? ? ?a,b??", "? ? ?a,b??", "? ? ? ? ?a,b??", such that for all formulas F in BD it holds that (M,T) $\ll F$. A behaviour description is *mentalistic*, if at least one ? occurs in one of its formulas. Otherwise, it is *observational*.

The aim of this paper is to assess under which conditions a mentalistic behaviour description BD can be rewritten to an empirically equivalent observational behaviour description $r(BD)$. Our first results show that although an elementary class of mentalistic behaviour descriptions can indeed be rewritten as desired, the formulas in the resulting observational behaviour description are so complex, that already at this elementary level there are strong pragmatical reasons to favour mentalistic descriptions.

Metaphor Processing in Text Understanding on the Web. A Hermeneutic Approach

Stefan Trausan-Matu

The search engines on the World Wide Web lack real text understanding capabilities. This is in dissonance with the success of the Web and with the ideas of Engelbard and Nelson according to which the hypertext (that they invented), the forefather of the Web, is considered as a tool for enhancing human understanding. One of the causes of this problem is the difficulty encountered by the developers of natural language processing tools to handle text semantics and pragmatics. Problems like understanding metaphors, discourse or authors' intentions are under investigation by computational linguistics and there are not yet computer programs that give satisfactory results.

Metaphors are often used to give insight in what a concept means. Metaphors offer other expressive means than traditional dictionary categorization-based definitions. We consider that the most important fact is that metaphors are used for a purpose, they reflect the writer's intentions. We could say, from a speech act theory perspective, that they have a strong illocutionary force.

Hermeneutic philosophers say that the experience, the believes, the context of the subject who wrote the sentence are of a major importance for understanding the meaning of that sentence. Therefore, for understanding metaphors and intentionality, natural language understanding computer programs must follow a hermeneutic approach.

We have investigated several approaches for metaphor and metonymy identification in texts on the Web using computational linguistics technology. For capturing the reasons for which a metaphor is used, we have developed a metaphor taxonomy where, for each concept (which can be a source of a metaphor) a set of attributes (transferred to the target concept) is defined.

Projectual Abduction

Giovanni Tuzet

Projectual abduction is the inference drawing the means to achieve an end. Planning a course of action is an inferential task: we claim that the relevant inference in such cases is abduction. We distinguish *projectual* abduction from *epistemic* abduction. While epistemic abduction aims to determine an explanatory relation, projectual abduction aims to determine a teleological relation. (Of course this does not mean they are not related). It is important to remind in any case that abduction does not stand by itself: as is true for epistemic abduction, projectual abduction has to be developed and evaluated by subsequent deduction and induction. We claim that the inferential articulation of abduction, deduction and induction (sketched remarkably by C.S. Peirce) holds not only for explanatory tasks, but also for practical and projectual tasks. This is how projectual reasoning determines the best means to achieve an end.

Before focusing on the modalities of projectual abduction, we focus on the relations between projectual abduction, normativity and truth. Projectual abduction has a peculiar normative character. It differs from other kinds of normativity because it depends on the existence of an empirically verifiable relation, that is a means-end relation that has a truth-value. Consequently, the norms expressed by projectual reasoning are true or false.

Then we sketch how projectual abduction works in artistic creativity, in evolutionary and teleological processes and finally in social processes. Concerning artistic creativity we refer to D. Anderson's work on Peirce, remarking how scientific and artistic methodology are proximate. Concerning evolutionary and teleological processes we claim projectual abduction has a fundamental role in developing intelligence and determining adaptation. Concerning the socially relevant projectual abductions, we refer in particular to legal projectual abductions, notably judicial decision making and legislation, claiming that projectual reasoning is an indispensable means of attaining or at least approximating social values.

Goodman's Paradox Generalizations

Evgenii Vityaev and Irina Khomicheva

In our paper we have examined the problem of induction drawing a line between the famous Goodman's paradox and the contemporary inductive inference. Goodman's paradox establishes the dependence of induction method on its language in the case of two predicates Green and Grue. We have shown that paradox in its pure form can be generalized to the paradoxical situation that appears for every step of hypothesis reinforcement. Such negative results are demonstrated for the rather general formalizations of induction problem in the case of two languages: the first order logic and feature space R^n with Euclidian metrics. Corresponding generalizations of Goodman's paradox are formally defined. Our further main contribution to the induction problem is a new stating of induction problem centered on introducing the strict frames of language/ontology. If the language/ontology possesses the world description using some second level laws of nature, then the possible inductive methods are strictly determined for these languages and can be realized as computational programs. It allows to avoid the omnipresent paradoxical situation and to obtain inductive methods most adequate to prediction purpose.

Emerging Truth: A Metamathematical Model

Mark Weinstein

The core of this paper is a set theoretic construction upon which an emerging notion of truth can be built. The inspiration for the construction is physical science as opposed to the standard model based on the foundations of mathematics and especially arithmetic. The viability of the model as a useful image presupposes that complex model relations can be identified and assessed. This seems to me to require significant transparency of articulation and considerable computational power. It is here that the relevance of the construction to artificial intelligence is to be found, for it is the availability of computation and the necessity of articulation within computer driven models that makes the construction more than an alternative metaphor. If the construction has sufficient clarity and intuitive appeal, the next step is to generate actual knowledge structures (complexes of facts, theories and inference rules) and see whether the architecture of the construction permits information otherwise unavailable to be found.

The key to the construction is to see epistemic adequacy as a function of, for example, explanatory adequacy over time, rather than as conformity to pre-existing models (e.g. predicted outcomes). For the latter the relation between theory and data is a function mapping expectations onto outcomes. This construction adds another function that maps from a deep explanatory base onto the theories upon which expectations are based. This allows us to among other things, choose between alternative theories even where expectations converge. Anther possible area of application is the calculation of prior probabilities based on the epistemic surround and in light of the conformity with data, degree of entrenchment of predicates, and the robustness of the inferences.

Black-Box Epistemology

Gregory R. Wheeler and Luís Moniz Pereira

Traditional epistemology concerns itself with the analysis of fundamental epistemic notions, such as justification, evidence and perhaps also belief and the analysis of key epistemic relations that appear to involve these concepts, such as is warrented by, is confirmed by, and is reasonable to infer. Strong (Cartesian) foundationalist accounts of justification rapidly fell from favor after 1960 in light of Gettier-style counter-examples, the paradoxes of rational acceptance (the lottery and the preface) and, indirectly, the paradox of the knower. This rapid succession of problems and puzzles gave rise to the "post-Gettier" focus on theories of justification, a period that we remain in today. The general lesson that mainstream epistemology has absorbed during this period is that epistemic properties don't at all behave like truth in a model. This led to the abandonment of logic as a constructive tool within epistemology and, aside from some work in the intervening years exploring modal logic and probabilistic representations, to abandon rigorous formal theories of justification in favor of informal descriptions of notions as 'truth-tracking', 'good evidence', 'basing relations' when not entertaining wholesale reformulation of epistemology in causal terms, a proposal to submit the 'reliable processes' of belief formation to empirical study and thus "naturalize" epistemology by turning it into a proper science. This period saw sketchy details for how the heavy-lifting demanded from various theories of justification was to be performs, in part because of the widely differing views on what propositions (or beliefs) should have the

appropriate epistemic standing. This "black-box" approach to epistemology—a tendency to settle for informal descriptions of key epistemic relations rather than rigorous formal definitions—is striking when one considers another field of inquiry initiated and rapidly developed during the same period: logical artificial intelligence. The various research areas of AI are familiar: learning, search, optimization, constraint satisfaction, belief revision, defeasible reasoning, planning, knowledge representation, natural language processing; and the range of possible areas of application is staggering: data mining, automated theorem proving, merging of hetrogenous databases, bio-informatics, to name but a few. The question that interests us is whether the fields of epistemology and logical artificial intelligence coincide. We think that they do, and in this essay we wish to make a case for why traditional epistemologists should attend to work within logical artificial intelligence.

The Paradoxes of Rational Acceptance and the Logic of Belief

Gregory R. Wheeler

This (much abridged) essay attempts to resolve the lottery paradox and the paradox of the preface within the framework of a non-monotonic logic called Statistical Default Logic, yielding a proposed solution to the two paradoxes that falls within the tradition of restricting closure operations on rationally accepted propositions. The essay advances a structural view of the paradoxes, one that holds that a solution to the paradoxes must (i.) offer a scheme for representing accepting less than certain propositions and (ii) provide a logic that preserves acceptance under entailment. The essay considers and criticizes a recent proposal advanced by James Hawthorne and Luc Bovens and points out a limitation inherent in (purely) probabilistic approaches to solving these paradoxes. The paper mentioned in the appendix is available from my web page, found by Googling 'Gregory R. Wheeler'.

The scheme of development of mathematics according to Lakatos and its application to the Riemann's scientific activity

Wieslaw Wójcik

There is a lot of different approaches to the history of mathematics. In this paper I pointed at the connection between various elements of culture and the development of mathematics. Moreover, I show that the history of science makes sense only when it refers to „the logic of development" of scientific theories. I present the Lakatos' view on the logic of development of mathematics. Further, I generalize the Lakatos's pattern for the research of history of mathematics. We can finally present the pattern of analyzing the history of mathematical structures (concepts, proofs) in the following way:

1. The first stage is the current definition of a given mathematical structure and the primitive intuitions connected with this concept (primitive hypothesis). Then, we place this structure in a „philosophical context", i.e. we show its connection with important philosophical problems. Then, philosophical tools are supplied, which will serve to compare the current definition with its understanding in various moments of history.
2. Historical analysis of the origin of a given structure and presentation of various efforts leading to its understanding.
3. Arriving at such a moment in a given theory development, which seems to call its sense into question.
4. While analyzing the origin of a given structure, we notice factors, which decide that it has a clear sense and is „non-contradictory"; at the same time it maintains the links with appropriate philosophical questions. It appears that the links once discovered allow to regard adequate historical facts as reasonable and rational events. In this moment a new understanding of a given concept appears. Further placing of this mathematical being in various historical contexts is performed only to clarify this context.
5. Next stage is a trial to find a revealed philosophical problem in different spheres. It is also important to analyze how the problem being described influences understanding of other philosophical questions. In this way, new research areas are opened.

The problem of indivisible quantities is significant for mathematics and philosophy since ancient time. There were many paradoxes and difficulties generated by it (e.g. Zeno's paradoxes). It was also a point of reference in scientific works of Bernard Riemann. I present some ideas of Riemann's, falling within his manifold theory, essential for understanding of the problem of indivisible quantities. Riemann introduces the concept of manifold in order to mathematically analyze the non-measurable quantities. They are examined as objects with a fixed location, as parts of a manifold, however, not expressible by means of any numerical units. Riemann wants to construct the concept of a multiple-extended magnitude, by means of general concepts of quantity. Defining of this concept is essential for understanding of the relationship between geometry and the concept of space and approaches us to correct grasp of the indivisible quantities.

Consequently, Riemann started to build the philosophical system connected with his mathematical research. Philosophical efforts of Riemann concentrate mainly on three papers: *Zur Psychologie und Metaphysik (On Psychology and Metaphysics), Erkenntnisstheoretisches (On the Theory of Cognition)* and *Naturphilosophie (Natural Philosophy).* These papers are not extensive, but form an outline for building a philosophical system based on results of natural sciences. For Riemann, not only the results of the sciences are scientific facts, but also philosophical deliberations and reflections e.g. of Kant and Herbart. A fatal illness and untimely death did not allow Riemann to finish his work. But I mean that it is possible to make a historical reconstruction of Riemann's philosophy and I realize partly it .