E-CAP'05

Abstracts

COMPUTING AND PHILOSOPHY

Västerås, Sweden, June 2-4, 2005,
Department of Computer Science and Engineering, Mälardalen University

KEYNOTE SPEAKERS

Greg Chaitin - *Alan Turing Lecture on Computing and Philosophy,* Meta Math The Quest for Omega

Barry Smith - *Carl Linnaeus Lecture on Ontology*, Biological Ontologies

Terrell Bynum - *Georg Henrik von Wright Lecture on Ethics*, Ethics for the New Millennium: Cybernetics and the Copernican Revolution in Ethics

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KEYNOTE SPEAKERS

Alan Turing Lecture on Computing and Philosophy

Epistemology as Information Theory: From Leibniz to the Omega Number

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In 1686 in his "Discours de metaphysique", Leibniz points out that if an arbitrarily complex theory is permitted then the notion of "theory" becomes vacuous because there is always a theory. This idea is developed in the modern theory of algorithmic information, which deals with the size of computer programs and provides a new view of Gödel's work on incompleteness and Turing's work on uncomputability. Of particular interest is the halting probability Omega, whose bits are irreducible, i.e. maximally unknowable, mathematical facts. More generally, these ideas constitute a kind of "digital philosophy" related to recent attempts of Edward Fredkin, Stephen Wolfram and others to view the world as a giant computer. There are also connections with recent "digital physics" speculations that the universe might actually be discrete, not continuous. This "systeme du monde" is presented as a coherent whole in my book "Meta Math!", which will be published this fall.

Carl Linnaeus Lecture on Ontology

Biological Ontologies

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Biomedical research increasingly involves the computerized navigation through large bodies of information, deriving from research in areas such as functional genomics or from the biochemistry of disease pathways. To make such navigation more effective, controlled vocabularies have been developed, which are designed to allow data from different sources to be unified by imposing a consistent use of biological terms. One of the most influential developments in this regard is the so-called Gene Ontology, or GO, created in the late 1990s by an international consortium of biologists and consisting of a list of some 20,000 standardized terms describing cellular constituents, biological processes and molecular functions, organized into hierarchies via relations of class inclusion and parthood.
Unfortunately GO as currently constituted, like many similar endeavors in the field of bio-ontology, is marked by a number of shortcomings which detract from its usefulness in supporting biomedical research. Many of these shortcomings relate to issues -- such as the treatment of space and time, of definitions and logical relations, of vagueness and prototypicality, of function and agency -- which are familiar to philosophers from the literature of analytical metaphysics. The talk will sketch the results of a project currently being carried out in conjunction with the GO Consortium, which seeks to use the lessons learned from philosophy in order to provide a rigorous logic of classification and a coherent ontology of bio-ontological relations that can be used as a foundation for systems like GO in the future.

Georg Henrik von Wright Lecture on Ethics

Ethics for the New Millennium: Cybernetics and the Copernican Revolution in Ethics

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In her 1995 ETHICOMP paper, "The Computer Revolution and Global Ethics", Krystyna Gorniak-Kocikowska predicted that the next major development in ethical theory would emerge from the new field of Computer Ethics. She was right. A new ethical theory is now emerging from the Computer Ethics community, and it is generating a "Copernican revolution" in ethics. This "cybernetic ethical theory" is rooted in a new account of the nature of the universe, a new understanding of life, and a new theory of human nature. Just as Copernicus's theory of astronomy permitted the older Ptolemaic theory to remain useful for those who cared to use it – and just as Einstein's new physics explained why Newton's older theory remained useable under certain conditions – so the new cybernetic ethical theory explains why earlier theories (like those of Aristotle, Bentham, Kant, Confucius, Lao Tse, and the Hindus) remain useful in the contexts for which they were developed. In addition, the cybernetic ethical theory offers powerful conceptual tools to deal successfully with future ethical issues of the coming millennium regarding cyborgs, "artificial" moral agents, and genetically engineered "super humans". Finally, for the religiously inclined, the cybernetic ethical theory provides a deep new sense in which human beings are made in the image of God.

INVITED SPEAKERS

The Logic of Being Informed

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At least since the fifties, logicians and philosophers have been able to formalise "cognitive" relations - especially those of knowing and believing - by means of specific logics, known as modal logics. A wealth of results are now available for epistemic logic (i.e. the logic of "S knows that p") and doxastic logic (i.e. the logic of "S believes that p"). In this paper, a specific logic is proposed in order to formalise the relation of information. More specifically, it is argued that a normal modal logic known as B (or Br), well captures our intuitions concerning what we mean when we say that "S is informed that p". The paper provides a brief and intuitive introduction to normal modal logics, their semantics and axiom systems. It is then shown how information logic may be formalised satisfactorily by means of B, and how it differs from a variety of epistemic/doxastic logics. It is hoped that the new modal logic in question, with the right semantics for the accessibility relation, will be helpful to explain several epistemological issues, including the possibility of a non-doxastic analysis of knowledge for artificial agents.

Building Mimetic Minds
From the Prehistoric Brains to the Universal Machines

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The imitation game between man and machine, proposed by Turing in 1950, is a game between a discrete and a continuous system. In the framework of the recent studies about embodied and distributed cognition and about prehistoric brains the machine Turing's "discrete-state machine" can be seen as an externalized cognitive mediator that constitutively integrates human cognitive behavior. Through the description of a subclass of these cognitive mediators I call "mimetic minds", the presentation will deal with some of their cognitive and epistemological aspects and with the cognitive role played by the manipulations of the environment that includes them.

Extended Body, Extended Mind: The Self as Prosthesis

Susan Stuart
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According to Kant 1781/87 & 1929] the most we can say about ourselves is that we are logical subjects of thoughts, necessary for the very possibility of coherent cognition. We look for the self, we reflect, and we find no thing, nothing that is the bearer of properties, and we try to conjure it up in the concept of a soul or mental thing [Descartes 1968], or a bundle of discrete perceptions [Hume 1739]. But we are looking in the wrong direction and must reorientate ourselves.
Self-consciousness requires the existence of a perceiving and conceiving being that acts and interacts with other objects and organisms in, what must at least appear to be, an objective world. It requires embodiment and embeddedness within its world; it is 'fallen'
[Heidegger 1962], necessarily adaptable, necessarily technological, extending itself through the use of tools, restoring lost functions and replacing lost organs and limbs. But also enhancing and reconfiguring itself, augmenting its capabilities and pushing itself further into its world and away from the first place we look. The self is not the body.
The self is not the mind. The self is active agency within the world; it is prosthesis.

The Epistemology and Ontology of Human-Computer Interaction

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This talk will analyze epistemological and ontological dimensions of Human-Computer Interaction (HCI). It is argued that the primary relation between humans and computer systems has historically been epistemological: computers are used as information-processing and problem-solving tools that extend human cognition. The talk will explore various types of epistemological relations that exist between humans and computer systems. What they all have in common is that in them, cognition is distributed, as cognitive activity is performed by two semi-autonomous information-processing systems that exchange information between them. The resulting system may be called a cognitive hybrid (hybrid cognitive system). Such hybrids are distributed information-processing systems consisting of a human processor and an artificial processor that process information in tandem. In this way, computer systems extend human cognition.
Next, it is argued that in recent years, the epistemological relation between humans and computers has been supplemented by an ontological relation. Current computer systems are able to simulate virtual environments that extend the interactive possibilities found in the physical environment. Virtual environments are micro-lifeworlds in which analogues of everyday perception and action take place, and in which human beings have experiential and behavioral relationships with the objects represented in them. This type of relationship is primarily ontological, and extends to objects and places that have a virtual ontology. Both the aforementioned epistemological relationship and this ontological relationship are unique to information technology and distinguish human-computer relationships from other human-technology relationships.

An Informational Approach to Biological Complexity

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This work explores a new understanding of physiological phenomena by revisiting the informational organization of the living cell. There is a presupposition that, contemporarily, the new fields of genomics, proteomics, transcriptomics, metabolomics, degradomics, signaling science etc. are in demand of a new information synthesis -the "systems biology" advocated by numerous parties. The approach followed here starts out from the molecular recognition field, which provides a unitary framework to analyze any further complexification of molecular-biological processes. In the living cell, the recognition encounters, or hits, between molecular partners embedded in informational architectures of sequential nature (DNA and RNA worlds) versus amorphous ones (diluted, amorphous assemblies of enzymes and proteins) are at the very center of cellular functioning. Properly establishing the functionality of the active elements -enzymes and proteins, the amorphous architecture- is in itself a "principled" matter that largely conditions the analysis of enzyme networks and the cellular cycle. How the stochastic function of the enzyme and its whole molecular-recognition circumstances (not only the probability of the "how", but also the "when", "where", "how fast", "with whom", and for "how long") have been coded together into the eukaryotic genome bears the hallmark of problem-solving universality at the molecular realm. In this sense, there emerges a striking parallel between the working cycle of the enzymic function and the eukaryotic cellular cycle, respectively understood as elementary functional components of cellular systems and of complex multicellular organisms. Finally, it will be argued that an old evolutionary dispute between allometric exponents in the species distribution of metabolic regimes (2/3 versus 3/4) may correspond not only to the search of energy/transportation optima, but could also correspond to direct optimization in an informational setting: the allegiance of organisms to the "partitional canon" in the progressive addition of further organismic parts taken as sub-summands in the distribution total of arithmetic partitions.

Emergent Properties and Inference Rules

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If one believes in the Darwinian picture of evolution, one has to accept the existence of so-called emergent properties and wholes. Through mutation and natural selection, completely new species have been caused to emerge. Similarly, if one believes that Gestalt psychology is right in its basic view that perceptions can, and mostly do, relate to non-reducible Gestalten of various sorts, then one has to accept emergent properties and wholes. Such perceptual Gestalten are not free-floating; they emerge on the basis of smaller perceptual units. The properties which they exemplify are, further, simultaneous with their constituents, and it is such emergent properties and wholes that I will focus on. Computer images are, in this sense, emergent wholes in relation to their pixels. At first, it might seem as if there cannot possibly be any formal inference rule that connects an emergent entity with its constituents. For if

there were, then it would seem that the entity in question would not be worthy of the label “emergent”. Partly, this is true. If e is a case of an emergent kind of whole E, and c is the relevant case of that complex of constituents from which e emerges, then there is no formal inference rule that says that from the existence of c one can infer the existence of e. Nor is there a formal rule saying that from the type C the type E can be derived. However, there is a more complicated inference rule that seems to be formally valid. It says:
Necessarily, if e emerges on the basis of the complex of constituents c, then everywhere where there is a case of C there is a case of the emergent whole E.

Cyberphilosophy and a Possible Foundation for the Future Oriental Philosophy of Techno-science in aFramework of Metaphilosophical Pluralism

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Cyberphilosophy, refers either to the Philosophy of Computing and Information (PCI) or simply the Philosophy of Information (PI). The terms: ‘computational turn’ and ‘information turn’ were first introduced in the 1990s to the international community of philosophy, and the research programme of the PI in 2002 in particular made PI an independent area of philosophical research. The scientific concept of ‘information’ is formally taken into philosophical inquiry. A new and tool-driven philosophical discipline of PI with its interdisciplinary nature is established. PI is an ‘orientative’ rather than ‘cognitive’ philosophy. Special attention should be paid to the orientative philosophy for it is more important than the cognitive philosophy both in the philosophical nature and profoundness.

An Iterative Model of Experimental Science

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In many areas of science the development of hypotheses goes hand in hand with the development of the experiments that elaborate, extend, verify or falsify them. Science studies scholars have noted the complex history of experimental work subsequently identified in terms of a final, definitive versions. They have also shown how experiments involve a dialectical play of ideas, instruments and phenomena in which each ingredient -- concepts, models, designs, instruments -- may go through many versions. On this view, the representation of experiments should refer both to the hypotheses that it is designed to explore or test and to those that are invoked during the process of learning to improve the 'fit' of theory and experimental results.
The specificity of an hypothesis is an important factor in experimental design, although the discriminatory power of experiment often lags behind what is required to discriminate between hypotheses. Proponents of inductive and deductive models of inference agree that the more specific an hypothesis is, the stronger the relationship between the hypothesis and the data that confirms or falsifies it. Falsificationist methodology considers only one hypothesis at a time, yet scientists typically have at least one alternative hypothesis (and sometimes several) in play. Moreover, falsification assumes that the objective is to eliminate hypotheses by deriving phenomenal consequences that can be negated by experimental results. This is accomplished by making the hypotheses (or predictions derived from them) as specific and as precise as possible. In practice the strict logical relationship of negation is achieved only in thought-experiments, rarely (if ever) in real ones. Nevertheless, we can take Popper's falsification proposal as an idealization in that the objectives of real-world experimentation are to bring results to bear on hypotheses as unambiguously as possible and to eliminate faulty assumptions and theories, as well as to evaluate and confirm plausible ones. This calls for improvements to experimental design so that trials match the degree of precision demanded by theory.

Models as Epistemic Artefacts: The Case of Constraint Grammar Parser

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How to approach the epistemic value of a language–technological artefact such as a parser? In which ways do parsers bring us knowledge and what kind of knowledge objects are they? In my presentation I approach these questions by discussing Constraint Grammar Parser, which can be characterised as a computational model of syntax. I argue that the traditional approaches to models in the field of philosophy of science do not make due allowance to the epistemic intricacies of the technological research, in which typically a special kind of expertise, bound to the specific models and methods of modelling, emerges. This seems to be especially the case of computer models, which in addition to being models are complex technological artefacts. As an implemented computer program designed give a morpho-syntactic analysis of a running text the Constraint Grammar Parser appears to be entirely unlike the abstract theoretical models of physics that are often taken as the prototypes of scientific models. It is difficult to say what parsers, like many other natural language processing tools, represent or even imitate. They are rather valued for what they produce and how accurate their output is. Thus, from the traditional philosophical point of view the Constraint Grammar Parser seems to be relatively uninteresting thing being merely an instrument. However, I shall argue that a promising way to approach models like parsers is to treat them as epistemic artefacts, that is, as constructed things that can give us knowledge in various ways and which also, in themselves, provide us new objects of knowledge. Moreover, approaching models as epistemic artefacts discloses the affinity of the parser to various other things scientists call models.

Translation Within and Between Languages

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Serious efforts to develop systems for machine translation have taken place for more than half a century. Some successful systems that translate texts in limited domains such as weather forecasts have been implemented. However, the more general the domain or style of the text the more difficult it has approved to reach good quality translation.
In the presentation, I will study some philosophical questions that underlie the difficulty of good quality translation. In order to broaden the typical view on the task, I make a distinction between translation within and translation between languages. As discussions, e.g., on Quine's notion of indeterminacy of translation have shown, the problem of translation does not only hold for translation between different languages but similar problems are encounterered when communication between users of same language is considered. The term intralingual translation has been used e.g. by Roman Jakobson. I will consider how intralingual translation relates to translation between languages and to the problem of sameness of meaning. In particular, I will present arguments for considering translation and meaning within the framework of continuous-valued multidimensional representations, probability theory and adaptive systems.

Ethical Assessment of New ICT-Systems in Health Care – Ethical Aspects.

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Since many years information and communication technology is used in health care. However, lately one can notice an accelerated interest for different kinds of ICT-applications, partly explained by the need of a faltering IT-industry to find new markets. ICT can in different ways enhance the practice of health care. However, it is necessary to examine the application of new technology in the light of the ethical values of health care. The new technologies must be instrumental in achieving the goals and values of health care and they must fit into health care practices.
In my presentation I will discuss the ethical implications of two computerised ICT-systems in health care. One is a system for patient surveys. The system makes patient information accessible to any authorised care provider irrespective of at what place in the organisation he or she works. The other system is a system for patient Internet accesses to his or her own medical record.
While both systems have very recently been introduced in health care practice it is too early to draw any empirically based conclusion about their value. However, it is particularly at this stage of technical development, i.e. before the technique is set, important to reflect on possible effects from an ethical point of view. This reflection should take into account both possible foreseen and possible unforeseen and unintended effects of the new systems. The first part of the presentation is devoted to this reflection.

The decision to introduce systems of this kind implies difficult and sometimes controversial ethical balancing. How should the systems be introduced and how can they achieve a broad acceptance and even perhaps a moral justification? In the second part of my presentation I will discuss these questions in relation to theories of participatory design, technology assessment and reflective equilibrium.

Causation – A Synthetic Perspective

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The debate about causation is livelier than ever in the history of philosophy. There are several completely different approaches. One train of thought is the Reichenbach-Salmon account, according to which causation fundamentally is a physical process. If a and b are causally related there must be a physical conncection between them, for example tranfer of momentum from a to b. A modern variant is to say that causation is transfer of a kind of information.
Another approach is the agency theory, which places the concept of cause in the human perspective of beliefs, actions and desires. The fundamental idea is that we identify causes in our surroundings just because we are agents in the world; we want to do things in order to foster or prevent certain states of affairs. We are interested in causal chains since identifying them helps us in planning our actions.
A third popular account is in terms of counterfactuals; 'a causes b' means 'b would have not have occured, had not a occured.'
In my view these approaches complement each other and Mackie's analysis of causation in terms of INUS-conditions provides the uniting picture. This, in turn is a development of Hume's view.
This perspective will be elaborated in the lecture.

A Neurophysiological Approach to Consciousness: Integrating Molecular, Cellular and System Level Information

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Consciousness is basically a biological problem, the greatest of biology today, but with philosophical consequences. How do the dynamically interacting electrical impulse patterns in sets of neuronal networks, forming brains, cause consciousness? We are approaching this problem along different routes and at different complexity levels.
At the system level we ask which brain structures are critical for creating consciousness. This problem is approached by testing how influential consciousness theories apply to the known fine structure of evolutionary different brain types. Our analysis suggests that avian and mammalian brains share functional features in spite of being structurally different, bringing reptilian brains into focus as the evolutionary first conscious structure.
At the cellular level we ask how the impulse patterns critically change when a brain goes into an unconscious state. This problem is approached by analysing the surprisingly little understood mechanisms of general anaesthesia. The received view is that general anaesthetics mainly affect a class of membrane bound proteins, ligand-gated channels. Our analysis shows that general anaesthetics also modify voltage-gated ion channels, and that such modifications can contribute to general anaesthesia by determining the firing pattern of the neurons.
How the density of voltage-gated channels affect the firing pattern in detail is analyzed by studying a cortical model neuron. The calculations show that the oscillatory activity can be separated into several distinct channel-density dependent firing patterns. This suggests that certain general anaesthetics can contribute to general anaesthesia by inducing a switch from firing frequencies associated with conscious states to frequencies associated with sleep or unconscious states.
The validity of these results is being tested by analysing the activity of cortical neurons of a mouse strain, in which a channel type has been genetically eliminated. The results suggest that the eliminated ion channel type is involved in sculpturing the impulse patterns and in general anaesthesia.

Philosophy of Computational Linguistics in the Small: Examples from my own research

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In my own work in the field of computational linguistics - work involving the design and implementation of among other things corpus tools, taggers, parsers and fullblown dialogue systems - I have often found myself drifting into a philosophical mode of thinking. Well, perhaps not philosophical in the sense of trying to deal with the 'big' questions about what 'really' exists, if knowledge is possible, or if the very idea of artificial intelligence is at all coherent. Rather, I would prefer to think of it as doing philosophy in the small - philosophy prompted by (what I have felt have been) small but strange anomalies in current linguistic theory, or by the mere practical needs of building useful systems. I have found myself drifting, for example, from working on a particular disambiguation method, into asking what the real nature of ambiguity is, or even into doubting the very existence of ambiguity. Trying to understand different methods for part-of-speech tagging - why they work and how we may be able to improve upon them - has sent me looking for ways to compare such methods, not only on the level of accuracy or efficiency, but also on the level of ontology, knowledge representation and inference. Lately, I have begun to explore the notions of interactivity and incrementality in the context of conversational software agents, arriving at a novel abstract characterization of such agents. These small excursions into the realms of philosophy have always been exciting, and occasionally very rewarding. Exercising a healthy criticism of received views, questioning the very foundation of what one is doing, always making new attempts to start and to restart from first principles, constantly striving for maximal conceptual and logical clarity, that to me is what philosophy - in the small or in the large - is all about. Now, needless to say, since I am first and foremost a computational linguist, I also believe that a syntactic, algorithmic level of explicitness is worth striving for, and that we should not rest until our theories are implementable. The eighteenth-century Italian philosopher Vico put it very well: ``Certum quod factum" - we are certain only of what we build.

Coordination for Quality in Flexible Education

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Mälardalen University has established a Centre for Pedagogy, ICT and learning (PIL). The activities are seminars, workshops, courses, reflection groups, project support and support from consultants. The educational portfolio for faculty is one of the cornerstones of PIL. The ambition of PIL is to meet the teachers in their daily chores and cooperate with them aiming at greatest possible student benefit. We extend our activities to the regional learning centres by inviting their staff to our courses. We stress the close cooperation between the educational consultant and learning technology consultant in our effort to built organisational structures to support the development. We take part in a number of infrastructural bodies to influence and coordinate the change from campus and distance education to a range of flexible courses, in so called “blended mode”. The quality management is guaranteed by PIL:s steering group with representatives from central functions within our university, such as deans, heads of departments, the head of the university library and students under leadership of the assistant vice-chancellor. The idea to develop a research environment in pedagogy in higher education with PIL as one of the participants has been initiated in cooperation with other universities, e.g. Lärande Lund.

Agent-Environment State Machines

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Traditional cognitive science and AI viewed cognition as computation, i.e., roughly speaking, the manipulation of internal representational knowledge of the external world through state machines (e.g., of the Turing machine type).
Most of this is strongly questioned in recent work on embodied, situated and distributed cognition.
However, using examples from robotic experiments and human case studies, this talk will illustrate that the notion of state machines is also useful in describing distributed cognitive processes emerging from the interaction of embodied agents and their environments, where knowledge and states are not purely internal, but distributed over agent and environment.

COGNITIVE SCIENCE

Getting Closer to Iconic Logic

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Visual representations of information and reasoning about it are gaining increasingly more ground in the contemporary intersections of logic, computer science and linguistics. I will argue that Charles S. Peirce's multi-part system of existential graphs (EGs), being a comprehensive representational system for the "action of the mind in thought" and "a moving picture of" it, is the best logical method in town for the purpose. By taking unpublished sources into account, I suggest that the true iconic logic of diagrams is to be found within those systems. These diagrams should be "as iconic as possible" in order to represent "visible relations". Contrary to Tim Crane's claims, for instance, it is seen that iconic, and in particular diagrammatic, representations of the facts are constantly formed and presented to the mind. But there are other icons, too. One of the key open questions is: Precisely what kind of logic corresponds to images and metaphors in the fashion in which the logic of graphs corresponds to diagrammatic icons? I will suggest that, by taking clues from cognitive semantics, it is the degree of analogicity contained in the representations and in the facts represented rather than the quality that distinguishes these three logics from one another, two of which are yet to be developed.

The Paradox of Autonomy: The Interaction Between Humans and Autonomous Cognitive Artifacts

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According to Thrun and others, personal service robots need increasingly more autonomy in order to function in the highly unpredictable company of humans. At the same time, the cognitive processes in artifacts will become increasingly alien to us. This is has several reasons: 1. Maturana's concept of structural determinism questions conventional forms of interaction. 2. Considerably different ways of embodiment result in incompatible referential frameworks (worldviews). 3. Engineers focus on the output of artifacts, whereas autonomous cognitive systems seek to control their input state. As a result, instructional interaction – the basic ingredient of conventional man–machine relationships – with genuine autonomous systems will become impossible. Therefore the increase of autonomy will eventually lead to a paradox. Today we are still in a position to anthropomorphically trivialize the behavioral pattern of current robots (von Foerster). Eventually, however, when self-organizing systems will have reached the high levels of autonomy we wished for interacting with them may become impossible since their goals will be completely independent of ours.

Meaning and Self-Organisation in Cognitive Science

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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.
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.

The Genesis of Representation

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The content of linguistic representation shared within the concepts of a human world has naturally and contingently evolved. Content, what it is that is an environment presents to an organism and causes it to act, emerged with life itself. Such content can only be described in the concepts of an observer within an observer's theory of cognition for an organism in its environment. For primitive organisms in which action is reflexive the level of environmental content which is represented in a cognitive theory is an observer's choice. But for those organisms, whether octopus, bird, dolphin, ape or human, in which representations are realised in informational structures which combine modes of perception to model space and time, what is represented is some substance within the world that has some affordance for that organism and neural science has now given us some insight into how this may be realised. Such modelling is itself a simulation but the fact that this may be simulated in a digital computer does not imply that these cognitive processes are computations. The world described by an observer is the human objective world framed in human concepts, some of which have been inherited from our hominoid ancestors. For each organism its cognitive structure models its world in the terms of its concepts and this world is real for it. However, this world cannot be described; it can only be shown.

Towards Automation of "Normal Science" through Empirical Machines

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Several researchers have suggested that we should strive for creation of artificial scientists. It is well known that the development of scientific theories and models is strongly e_ected by the perceptual and conceptual limitation of human scientists. While some of these, e.g. perceptual limitations, can be overcome through the use of tools, e.g. microscopes, others might be better overcome by the complete automation of the scientific process. The scientific knowledge is also a convenient form of knowledge to study and may be more suitable starting point when developing artificial intelligence than "common sense knowledge". However, the ideas of "artificial scientists" are very seldomly accompanied with a concrete plan for how to do this in practice. As a first step we suggest to focus on simpler, computational domains, and on the purely empirical process of model building and observation. For these computational domains, it is much easier to create large numbers of new computational models and observations than to actually understand any of them, which suggests that there is a need for automating the analysis process. As an example, this is already beginning to be realised within the field of recurrent neural networks from which finite state automata are being extracted. This is perhaps also a good field to start with since these networks can be quite complex, and are a subclass of a wide set of input-driven dynamic systems. We propose that certain aspects of Kuhn's "Normal Science" could be automated with what could be called Empirical Machines which automatically build models of phenomena they are selected to analyse. These machines should be guided through sound scientific methodology, e.g. according to Popper's principle of falsifiability, and through the queries of (human) researchers. To start with computational modeling can be a feasible path towards artificial scientists.

Searching for the Gregorian: a Suggestion for New Directions in Situated Robotics

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The traditional emphasis on internal computation and representation within cognitive science has during recent years been attacked by researchers that emphasize the close coupling between brain, body and world. This new emphasis is illustrated by the emergence of new approaches, such as situated robotics, within which real or simulated robots controlled by artificial neural networks are used as models of cognition. While this approach has been successful in the study of more or less continuous and reactive sensorimotor interaction between agent and environment, it has been argued that the models will not be able to scale up to higher-level cognition often thought to require some kind of inner model of the external world (e.g., Clark & Grush, 1999). In this paper, we review the previous and current work of situated robotics and discuss the prospects of investing higher-level cognition in such models. The review is structured by using the hierarchy of increasingly representationally complex creatures of Daniel Dennett as a scaffold. In Dennett's hierarchy, the two simplest animals are equipped with simple sensorimotor couplings that can be changed either by evolution (Darwinian creature) or experience (Skinnerian creature), while the two more complex creatures are able to model the world to anticipate future events (Popperian creature) and extend their cognitive abilities by using tools and artifacts (Gregorian creature). The review shows that while most work has centered on the two simpler creatures, less work has been investigating the two more complex creatures. A possible reason for this gap is argued to be the lack of understanding and use of embodied theories of internal and external cognitive states in situated robotics. The paper ends with a discussion of a possible synthesis of so called emulation theories of representation, which view cognition as the covert reactivation of perception and action, and distributed cognition theories, which emphasize the active use of the environment.

Do Animals and Machines Think like Humans? – a Cluster Analytic Approach

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Asking whether animals and machines think like humans brings up the question of how to define 'thinking'. In the history of the concept 'thinking' its definition has often been adapted to current scientific developments so that it only applied to humans. Yet recent scientific developments seem to melt away this anthropomorphic restriction on thinking. To discuss different definitions of thinking used in different disciplines and to investigate, who or what can be called 'thinking', I use cluster analysis, an unsupervised classification method that yields a class structure based on statistical properties of the input data.
As a first example I provide an analysis based on the distinction between implicit (perception, motor-control, thinking how) and explicit (mathematics, language, thinking that) cognitive abilities, which nicely illustrates the problem of anthropomorphic definitions of thinking. If you define thinking only by explicit abilities, as normally done before the computer age, you will have no problem to keep animals out of the extension of the concept. With machines playing chess as good as humans, you have to include implicit cognitive abilities to keep machines out. But research in animal cognition suggests that animals show a high degree of implicit and also explicit cognition endangering our exposed position
I will provide and compare results of cluster analyses based on different concepts of thinking taken from various disciplines, e. g. psychology, cognitive ethology, artificial intelligence. These involve diverging cognitive skills in different combinations and with different weighting such as social learning, language skills, abstract representation, cognitive maps. For the sake of simplicity I will focus on a few species including humans, chimpanzees, crows, ants, PCs, AIBO (Sony), ASIMO (Honda) and others. The result should show, how the list of cognitive skills used in certain disciplines is influenced by the community's preference to include or exclude entities from thinking.

Embodiment and Human-Computer Game Interaction

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The activities of using computer applications and playing computer games have clearly much in common as both require humans to interact with a computer based interface. For some reasons, researchers interested in games have largely focused on the (psychological) impact that games have on people, but relatively little on game interfaces and game usability. In recent years, even the HCI-community has picked up on the increasing interest in games. One of the main concerns of HCI researchers has been how game technology best could be applied to and used in standard computer applications. Having a background in cognitive science, we would like to suggest and discuss a few ideas related to human-game interaction with an emphasis on embodiment aspects. Using simply a keyboard in order to navigate through a virtual environment must feel quite unnatural for most people. Human-game interaction does, in other words, not necessarily have to be limited to a number of buttons on a keyboard or a joystick. Having, for instance, the opportunity to actually walk through a virtual environment may have a positive impact on to what extent people can recall details from their walk. Our ideas are based on theories within the theoretical framework of embodied cognition where researchers heavily stress the importance of body actions to human cognition.

Approaching Artificial Intelligence for Games - The Turing Test Revisited

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Today's powerful computers have increasingly more resources available, which can be used for incorporating more sophisticated AI into home applications like computer games. The perhaps obvious way for using AI to enhance the experience of a game is to make the player perceive the computer-controlled entities as intelligent. So, what makes people willing to set aside their knowledge that the entity is artificial and not human? The traditional idea of how to determine whether a machine can pass as intelligent is the Turing test. In this paper we argue that it is possible and useful to conduct a test adhering to the intention of the original Turing test. We present an empirical study exploring human discrimination of artificial intelligence from the behaviour of a computer-controlled entity used in its specific context and how the behaviour responds to the user's expectations. In our empirical study the context is a real-time strategy computer game and the purpose of the AI is merely to pass as an acceptable opponent. In the full paper, we will present and discuss the results of the empirical study conducted and its implications for AI in computer applications.

Reaping the Best of Both Worlds: The Body-In-Motion Meets Cultural Cognition

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Although embodiment has become a crucial concept in many areas of cognitive science in recent years, the term obviously still means different things to different people. Several authors have lately tried to clarify different notions, aspects, and levels of embodiment that can be found in the cognitive science literature. The lack of agreement, however, has resulted in some oversimplifications of the role of the body in cognition. On the one hand, much focus has been on different kinds of physical realization of the 'static' body, despite the fact that research in anthropology has shown the relevance of locomotor experience for human cognition. On the other hand, a lot of attention has been directed on the relation between the individual body and individual processes, but it is well-known that embodiment is of importance also in social interactions. We stress that the "body-in-motion" is of crucial relevance for human social interaction. Around the age of nine months, children begin to participate in social discourse developing various kinds of "joint attention behaviors", which characterizes the ability to "identify" with others and understand them as intentional agents – the so-called "nine-month revolution". Why does this revolution occur at that age? Our conjecture is that self-produced locomotion behavior is a crucial factor for the emergence of the social understanding of the self. When the child begins to crawl and creep voluntarily, which usually also occurs at the age of 9 months, the interaction between the child and the physical and social environment is changed radically, since the child receives social signals that have a distal referent, making it possible for the child to grasp that others also have intentions. The point I want to make is that the onset of self-produced locomotion and the "nine- month revolution" coincide in time. I suggest that this is in fact no coincidence at all, since the sensorimotor and social dynamics of bodily experience function as a crucial driving force in cognitive development.

Philosophical Lessons in Autism for Artificial Intelligence

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Autism is a neurobiological developmental disorder characterised by impairments in communication, imagination and social interaction skills. Following Wing's research into the heterogeneity of the condition a spectrum of autistic disorders has been identified. Currently there is no single accepted causal explanation of autistic disorders. However, there is agreement that these disorders are organic and life long in persistence. What is the relevance of this unfortunate condition to computational science? Well if not autism per se, at least theorising about autism, should be of interest to artificial intelligence (AI) for one profound reason: many of the mysteries and problems affecting the development of AI are coincident with similar ones exhibited in autism. For example, what are the conditions for effective reciprocal communication among 'agents' at whatever level of intelligence? What would have to count for an agent to have a theory of self and world without sliding into solipsism? How can a reasonable altruism be brought about among agents? Can commonsense be inculcated in agents with 'socially negative' cognitions? Of course, these questions are not uniquely associated with the areas cited here. They have a profound history in philosophy and a gathering presence within AI research over the past thirty years. What is striking nevertheless is that these questions have arisen within specific paradigmatic interpretations of human condition not entirely discordant with classical notions of robotic intelligence. Given the medical characterisation of autism, it may come as a surprise to learn that theoretical explanations of its varieties of manifested consciousness and cognitive mechanisms are rooted in philosophical explorations of the self, intentionality and the mental organisation of information processing. Arguably, most of the work implies quite a thin theory of rationality. However, there is one potentially broad theory based in understanding self-and-other intersubjectivity. The heuristic here is that in teasing out the philosophical implications of the parallels between this work and AI concerns about agency, important gains in understanding the sufficiency conditions for agency and agent interaction can be made.

Choosing between different AI approaches? The scientific benefits of the confrontation and the new collaborative era between humans and machines

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There are two main approaches to Artificial Intelligence (AI) research: top down and bottom up. Both approaches have offered great results and both solve difficult problems, one the main aims of scientific activity (according to Laudan). We can also infer from last decades that the diverse AI efforts are not the contemporary version of medieval perpetuum mobile debates, this time in the field of robotics, cognition and computation, with the idea of 'intelligence' as the main subject of analysis. Philosophical argumentations against classical AI (Searle's Chinese Room …) are far from the reality and scope of its development. Philosophers are fighting with a chimera, while AI is more and more crucially embedded on scientific practices and discourses.

AI is being successfully implemented on scientific reasoning by several ways. So, beyond philosophical academic arguments against or in favour of AI, there is a rational and framework space in which we can analyze and talk about the results Artificial Intelligence over several scientific disciplines. Bioinformatics, expert systems (such as DENDRAL, MAXIMA, MYCIN,…), or lab robots like Robot Scientist, are examples of it. We must think about other contributions of computer science and its meaning for daily activity and news ways of thinking: hypertextual forms (webcrawlers, websites, hypertext, e-mail, chats, cyberspace forums, blogs), computer-aided education (Tarksi's World, Hyperproof, hypermedia), online databases, digital media or leisure spaces. As I will defend, we are assisting to a computerization of science (thanks to the result of different AI approaches) and life (virtual communities, hacktivism, e-democracy, flash mobs, book-crossing,…). And we can find as first time in human history, cooperation between scientists and civil society through distributed computation (seti@home, genome@home,...).

The efforts of computer and AI scientists are changing completely our societies, our science and our own thoughts. Perhaps we have now "Technothoughts".

A Neuroscientific Barrier to Situated and Embodied Artificial Intelligence

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While classic AI systems still struggle to properly in- corporate common-sense knowledge, Situated and Em- bodied Artificial Intelligence (SEAI) aims to build an- imats that acquire a common-sense understanding of the world via interactions between simulated brains, bodies and environments. Neuroscientists believe that much of this common sense involves predictive models for physical activities, but the transfer of sensorimo- tor skill knowledge to cognition is non-trivial, indicating that SEAI may meet a daunting challenge of its own. This paper considers the neurological basis for procedu- ral common sense and the possibilities for its transfer to conscious reasoning. This helps assess the prospects for SEAI to eventually surpass GOFAI in the quest for generally intelligence systems.

Available Information - Preparatory Note For a Theory of Epistemological Space

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We can imagine how in the distant past the epistemological space of sentient beings more or less coincided with physical space: to know some contingent fact of the world you would have to be there and at that particular moment and actually sense it. In the age of information, the shape of epistemological space is brought to deviate more and more from the shape of physical space. Establishing a telegraph or phone connection brings objects distant in physical space close in epistemological space. Books draw together information scattered in physical space, making it available at each point in physical space where a copy is at hand. Epistemological space is warped by information technology, and the newest information technologies bring this development to a head. We may dream of having all epistemic resources instantly available, but the goal of making all information equally and instantly at hand (not to mention everywhere) is self-defeating. It is not just unattainable, it is not even an approachable ideal, it is impossible in principle. In order to make better use of epistemological space we need to understand it better. Epistemological distance is suggested as a basic conceptual tool needed in order to begin to explore the shape and laws of epistemological space. Intuitively, the distance to a piece of information is its virtual availability: the time it takes to access it, to bring it to the fore, to produce it, irrespective of implementations and methods used. Two basic issues when you want to measure the distance to some kind of entities are what the appropriate kind of entity is, and how the presence of such an entity can be determined. In this case: What does it mean to “have” knowledge, and what is it that you have when you have it?

Is Computationalism Trivial?

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In this paper, I want to deal with the triviality threat to computationalism. On one hand, the controversial and vague claim that cognition involves computation is still denied. On the other, contemporary physicists and philosophers alike claim that all physical processes are indeed computational or algorithmic. This claim would justify the computationalism claim by making it utterly trivial. I will show that even if these two claims were true, computationalism would not have to be trivial.
First, I analyze the vague definition of computationalism. By showing how it depends on what we mean by 'a computational process', I distinguish two main flavors of computationalism claim:
That cognitive processes could be described algorithmically (in G. Chaitin's sense of 'algorithmic')
That cognitive processes are algorithmic or computational (they implement recursive functions).
This second claim could be analyzed further as a claim: That cognitive processes could be described as computational; That cognitive processes are really implemented computationally or That cognitive processes are generated by computational processes. I distinguish then three varieties of computationalism. The first is that cognitive processes can be simulated computationally; the second is that they can be realized computationally; the third is that cognitive processes are generated by overall computational processes. This last sense is on the verge of being trivial if we accept that all physical processes are computational.
I show that the non-trivial computationalism involves a multi-level model of cognition where certain level of organization of processes is emergent on the base level. This base level could be even conceived of as algorithmic but the emergent computational level would implement other algorithms than the base level. I try to sketch a multi-level model of cognition which involves computation without being at the same time trivial.

The April Fool Turing Test

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This paper explores certain issues concerning the Turing test; non-termination, asymmetry and the need for a control experiment. A standard diagonalisation argument to show the non-computability of AI is extended to yields a so-called “April fool Turing test”, which bears some relationship to Wizard of Oz experiments and involves placing several experimental participants in a symmetrical paradox – the “April Fool Turing Test”. The fundamental question which is asked is whether escaping from this paradox is a sign of intelligence. An important ethical consideration with such an experiment is that in order to place humans in such a paradox it is necessary to fool them. This issue is also discussed.

Commonsense Spatial Reasoning: from Pervasive Computing to a Philosophical Perspective

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Pervasive Computing has become a very important topic in Computer Science. A particularly strong relationship holds among pervasive systems and the spatial environment they habit. Various kind of reasoning tasks that must be carried out by these systems need to take into account a spatial model of the environment in order to exploit spatial information to draw domain specific inferences.
In order to support spatial reasoning in the Pervasive Computing area, this paper presents a Commonsense Spatial Model that focuses on the notions of "place" and "commonsense spatial relation". Some philosophical issues concerning the concept of place and of commonsense spatial relation will be discussed. In particular, three main classes of relations (Orientation, Proximity and Containment) will be defined and formally analysed.
The commonsense spatial model essentially consists of a relational structure and, therefore, it can be viewed as the semantic specification for a Hybrid Modal Logic, according to traditional kripkean possible worlds semantics.
The proposed commonsense approach to spatial reasoning will be put in relationship with some philosophical observations about the notion of space proper of the transcendental phenomenology of Edmund Husserl. We will argue that some husserlian intuitions are extensible to human artefacts, such as a pervasive systems, in order to justify a different approach to spatial reasoning, which focuses more on the representation of the space generated by the presence of the system in the environment, than on the representation of the morphological properties of the environment itself.

Recurrent Misconceptions of Computation

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Computationalism, the view that mental states are computational states, has been rejected by various subcommunities in cognitive science in the recent past, from dynamicists who view brains as intrinsically dynamical systems, to proponents of an embodied and situated view of cognition that emphasis the interactions of brains and the bodies they control as well as the intrinsic embeddedness of cognitive systems in their environments. The major line of attack advanced by dynamicists, criticizes the “non-dynamical nature” of computational systems. Specifically, van Gelder (1998) has argued that what is essential to computation is the notion of an effective procedure, and essential to that is the notion of discrete steps in an algorithm. He claims that this discreteness, in both its temporal and non-temporal aspects, prevents computation from explaining many aspects of cognition, which he considers to be fundamentally dynamical phenomena. Another attack, also advanced by dynamicists, challenges the role of representation in cognitive science in general, and a forteriori can be seen as a challenge to the role of computation in cognitive science. Especially psychologists have argued that certain allegedly “cognitive” tasks have nothing to do with cognition proper, but are really motor control tasks that can be explained and modeled in the language of dynamical system without resorting to manipulations of representations (e.g., see Thelen and Smith, 1994). Other criticisms come from philosophers who, for example, argued that mental states are relationally individuated (Putnam, 1975), while computational states are not (Fodor, 1981), from which it is concluded that computation cannot explain mentality (Putnam, 1988, Fodor, 1994). Another line of attack is pursued by those who argue that computations are arbitrarily attributatble to physical objects (Putnam 1988, Searle 1992), while mentality is not. While the different critiques of computationalism vary, they share a common theme: computation fails as an explanatory notion for mind, because computation necessarily neglects the real-time, embodied, real-world constraints with which cognitive systems intrinsically cope.

On Facing up to the "Semantic Challenge"

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Computational neuroscience is founded on the computational hypothesis of the mind/brain: that neural systems are automata that compute information by their state transitions, and that understanding this property is useful for accounting for much of the intelligence we observe in the behavior of organisms (Sejnowski et al. [1988].
In a recent paper (Grush [2001]) Rick Grush presents computational neuroscience with a 'semantic challenge': how to distinguish between computation – "genuine information processing" - and any other complex causal process merely governed by a computable rule. Grush himself frames this problem in terms of a distinction between a-semantics and e-semantics: conformity of the neural process to a mathematical algorithm, and isomorphism of a neural structure to something that it is used to "stand in for" in the brain.
In this paper, Grush's a-semantics and e-semantics are reframed in terms of a more general distinction between "horizontal" semantics (based on the notion of causality and isomorphism) and "vertical" semantics (based on the idea of information coding in formal systems). It is put forward that the semantics that computational neuroscience needs in order to address "the semantic challenge" must be vertical. a-semantics is "bottom up" vertical semantics, and indeed inadequate. This inadequacy, however, is explained as stemming from the fact that what you really need is "top down" vertical assignment of semantics: "c-semantics".
Finally, it argued that Grush's own solution, e-semantics, is a case of horizontal content-assignment, which is not what one should be looking for. Based on considerations of intensionality and "poverty of the stimulus", it is maintained that tha c-semantic, not an e-semantic nor an a-semantic, definition of content is the genuinely mentalistic notion of information that would be needed as a coherent philosophical foundation.

Does Dynamical Modelling Explain Time Consciousness?

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1. One of the fascinating features of conscious experience is its temporal structure. When I am listening to a song, I am conscious of the notes that I hear now for the first time. But I also seem to be conscious of the notes that I heard a moment ago, and through my anticipations I even seem to be conscious of the notes I have not yet heard.
2. Husserl's famous model of time consciousness has three aspects. There is the "primal impression" directed to the notes heard "now". But there is also an awareness of the "just past" ("retention") and even an awareness of the tones to come ("protention"). Husserl thought that retention and protention are perceptual processes. At the same time he realized that the idea that we would literally perceive the past is paradoxical. According to the usual view of time only the present and what is in it exists; the past no longer exists, the future does not yet exist. How could we possibly perceive that which does not exist?
3. van Gelder has proposed that time consciousness can be approached by considering a dynamical model of auditory pattern recognition. Here the state of the system at any given time models the awareness of the auditory pattern at that moment. Van Gelder suggests that this state builds the past and the future into the present, which is what Husserl required. However, van Gelder denies the idea that retention involves perception of the past.
4. I propose that even the dynamical approach fails to give an intelligible account of time consciousness. van Gelder just eliminates an essential aspect of time consciousness, namely the perception of previously experienced elements. A more adequate account can be provided within David Bohm's "implicate order" framework. This allows for a continued perception of previously heard notes, because these are understood to be "enfoldments" that actually are in the present moment. Because Bohm's approach builds upon a richer (quantum physically inspired) view of time and movement, it can better than Husserl's make sense of the idea of retention as "perception of the past".

The Embodiment of Perception: A Case for Semantic Level Representations

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Embodied perception can be viewed in terms of the fundamental role the body and its representation play in (human) perception. I suggest that a further aspect of embodied perception is the role of high level semantic representations. This level of representation is adaptive in the sense that it allows us to prepare for action and supports interaction with objects and other individuals. Behavioral data and data from neuroimaging studies indicate a functional role for high level representations. One area of research where the semantic level of representation is quite clear is the perception of biological motion using point-light displays. People easily see the actions represented in these displays as well as seeing other non-explicitly represented information. Research on mirror neurons, for example, shows that our bodies and action representations are used as templates and simulations in order to understand the potential for action and interaction. Within attention, a recent theory, Reverse Hierarchy Theory (Hochstein & Ahissar, 2002), proposes that explicit visual perception begins with high level processing in the visual hierarchy. Explicit visual processing is the result of implicit processing of feedforward mechanisms in low-level vision. This endows humans with the ability to de-couple representations from the situations that trigger them. It also allows us to use the representations 'off-line' to predict the consequences of planned actions in terms of their potential sensorymotor effects.

Cognition Without Content

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According to the traditional conception of the mind, semantical content is perhaps the most important feature distinguishing mental from non-mental systems. And this traditional conception has been incorporated into the foundations of contemporary scientific approaches to the mind, insofar as the notion of 'mental representation' is adopted as a primary theoretical device. On Fodor's Language of Thought hypothesis, symbolic representations are posited as the internal structures that carry the information utilized by intelligent systems, and they also comprise the formal elements over which cognitive computations are performed. But a fatal tension is built into the picture - to the extent that symbolic 'representations' are formal elements of computation, their alleged content is completely gratuitous. Computation is essentially a series of manipulations performed on uninterpreted syntax, and formal structure alone is sufficient for all effective procedures.
Fodor argues that the brain-like architecture of connectionist networks tells us nothing about their suitability as models of cognition, since it still leaves open the question of whether the mind is such a network at the representational level. A number of connectionists have taken up the challenge and seek ways of projecting representational content onto artificial neural networks. One such attempt uses cluster analysis to locate 'vehicles' of content. I argue that such attempts suffer from exactly the same tension that afflicts the LOT model - the purported content for which the clusters serve as vehicles does no work in the processing path leading from inputs to outputs. I argue that the computational paradigm is thematically inconsistent with the search for content or its supposed vehicles. Instead, computational models of cognition should be concerned only with the processing structures that yield the right kinds of input/output profiles, and with how these structures can be implemented in the brain. When it comes to computation and content, only the vehicle is required, not the excess baggage.

Simulation and Computability: Why Penrose Fails to Prove the Impossibility of Artificial Intelligence (and Why We Should Care)

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In two widely-read books, Roger Penrose resuscitates an argument (originally considered by Gödel, Turing and Lucas) against the possibility of formalising human thought, and by extension, against the possibility of artificial intelligence (AI). The argument is essentially logico-mathematical, drawing on principles used in Cantor's diagonal argument and Gödel's incompleteness theorem, and concludes that there is a function F (a variation on the halting function) that humans can compute which no Turing machine can. After briefly reviewing the argument, I argue that it fails to support Penrose's claims. Exploiting an insight arrived at independently by Whitely, I contend that while Penrose's formal argument (for the claim that humans can compute F, but no Turing machines can) is sound and valid, the informal, sceptical conclusion concerning AI that he draws from it is a non-sequitur. Specifically, the fact that no Turing machine can compute F, yet humans can, does not imply that there are aspects of human cognition that are not simulable by any Turing machine. I show this by considering an analog of the halting function, defined in terms of humans rather than Turing machines. Seeing how this "person halting problem" refutes Penrose requires re-examining our notions of simulation, computability and function individuation, making the position of relevance to those not concerned with the possibility of artificial intelligence. In particular, the position implies that according to orthodox criteria for individuating functions, there can be no Universal Turing machine (i.e., there can be no Turing machine that can compute all Turing-computable functions). I suggest an alternative means of function individuation that preserves the possibility of Universality, and explore some of its consequences for computability theory.

E-Testimony and Justified Belief

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A central issue in the contemporary epistemology of testimony is whether or not testimony is a fundamental source of justification. Reductionists argue that testimonial evidence can be reduced to more basic sources, such as perception and memory. A central argument of some of those who have argued for the non-reductionist position is that we rely on testimony in our justificatory and inferential practices in a way which does not appear to require other sources of knowledge beyond those needed for the perceptual and memorial processing of testimony. They claim that testimony is very often non-controversial and widely accepted, that even where it is not, we often can't find and don't require non-testimonial grounds for our beliefs. This paper explores the question of the justificatory status of testimony in light of the emergence of what I refer to as e-testimony, the electronic transmission of testimony through such electronic media as e-mail, the web, instant messaging, and file-sharing. Emerging practices with these media raise a host of questions about the nature, character and quality of testimonial exchange. While the underlying epistemic principles employed in electronic communication may not be new, the special features of electronic transmission of testimony may require a significant reappraisal of the empirical claims (if they are empirical claims) about testimonial transmission in the application of those epistemic principles. The paper examines the cognitive and epistemic principles at work in the evaluation of e-testimony in e-testimony. As our testimonial transmissions increasingly become e-testimonial transmissions, most of what we receive as testimony is likely to be evidentially unreliable. Does it follow from this that the rational epistemic response is to find non-testimonial sources of justification and eschew testimony, both ordinary testimony and e-testimony? Reflection on the epistemic status of current e-testimony suggests an anti-reductionist strategy. The trust models we will need to develop for distinguishing credible from false e-testimony will themselves largely rely on testimony and on e-testimony itself.

Advanced Synthetic Characters, and One (E) From the "Dark Side"

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We describe our general approach to building what we call advanced synthetic characters (or bona fide virtual persons), within the paradigm of logic-based AI. To focus our general approach, we provide a glimpse of our attempt to bring to life one particular virtual person from the "dark side" — the character known simply as E (for, as you may have guessed, evil). Building E entails, among other things, that we formulate an underlying de.nition of evil through philosophical analysis, and that we manage to engineer as well an appropriate presentation of E. At the presentation level, we use an approach based in manipulating facial musculature.

Artefacts, Cognition and Collective Behavior: Towards a Framework for Finding the Holy Grail

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Cognitive science has traditionally been based on the idea of internal computation, and cognitive processes have been considered confined to the individual's brain while the environment has by and large been reduced to inputs and outputs. More recent situated, embodied, and distributed theories move the boundaries of cognition "outwards", emphasising the importance of social and material environmental resources. Research has given us knowledge for instance on cognitive artefacts and their role in cognition, and in collective activities. Despite a growing emphasis on external resources, and a great many studies including artefacts, we still have a poor understanding of the ways people utilise and adapt artefacts in daily activities to support their cognitive abilities. It has been pointed out that the most important task we are facing is to better understand non-biological cognitive scaffolding, and the ways they augment our cognitive capabilities (Clark, 2002). This paper proposes a framework concerning artefacts and human activities, based on the combination of three concepts related to environmental resources: triggers and placeholders (Dix et al., 2004), and entry points (Kirsh, 2001). A trigger is something that prompts an activity, something that tells you that you need to do something. A placeholder is something that tells you where in the process you are, what you need to do. Entry points refer to structures or cues that represents an invitation to enter an information space, that is, they invite people to do something. Together these concepts comprise agent and environment, activites and temporal aspects, and provide a starting point for a more principled understanding of the role of artefacts in human activities. The framework is illustrated by a case study conducted in a collective work setting where artefacts take a central role in the coordination of ongoing work processes.

Memory Versus Logic: Two Models of Organizing Information and Their Influences on Web Retrieval Strategies

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The first anticipation of the World Wide Web hypertextual structure can be found in Bush paper of 1945, where he described a "selection" and storage machine called the Memex, capable of keeping the useful information of a user and connecting it to other relevant material present in the machine or added by other users. We will argue that it is not by chance that was Vannevar Bush who conceived this type of machine. During the 1930s, in fact, he invented and built the Differential Analyzer, a powerful analogue machine that was used to calculate various relevant mathematical functions. The model of the Memex is not the digital one, because it relies on another form of data representation that emulates more the procedures of memory than the attitude of the logic used by the intellect. Memory seems to select and arrange information according to association strategies, i.e., using analogies and connections that are very often arbitrary, sometimes even chaotic and absolutely subjective. The organization of information and the knowledge creation process suggested by logic and symbolic formal representation of data is deeply different from the former one, though the logic approach is at the core of the birth of computer science (i.e., the Turing Machine and the Von Neumann Machine). We will discuss the issues raised by these two "visions" of information management and the influences of the philosophical tradition of the theory of knowledge on the hypertextual organization of content. We will also analyse all the consequences of these different attitudes with respect to information retrieval techniques in a hypertextual environment, as in the Web. Our position is that it necessary to take into accounts the nature and the dynamic social topology of the network when we choose information retrieval methods for the network; otherwise we risk creating a misleading service for the end user of web search tools (i.e., search engines).

Mathematical Operations as Manifestations of Cognitive Functions

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We suggest that some of the well-known mathematical operations may be manifestations of certain cognitive functions of the brain. We investigate the examples of Fourier transformation and orthogonalization of vectors and argue that the brain possesses an orthonormal basis as an integral part of its memory storage strategy, which enables it to virtually perform Fourier transformation. Besides, the brain also possesses the capability to construct orthonormal bases in order to discriminate between the incoming information and the stored information. While the first one, which may be a part of the brain's hardware, is essential for its memory system to be robust against trauma, the latter ones are generated specifically for, and by the incoming information for them to be classified and categorized. We show that Fourier transformation could be the manifestation of two of the brain's capabilities related with memory: (i) it may integrate the information arriving from di_erent sense organs; and (ii) having formed the memories like this it may be employed in consolidating them into the long-term memory areas. The operation (i) may happen in the hippocampus whereas (ii) may be operated in the areas between the hippocampus and the cerebral cortex. The Fourier transformation can spread the memories in the longterm memory areas in such a way that each synapse contains the entire information of a memory being stored. Orthogonalization could be the manifestation of the brain's capability to compare two memories to identify their similarities and di_erences. We argue that the brain may be storing these similarities and di_erences, i.e. the orthogonalized information, rather than the full information. Orthogonalization has another significant feature — it enables storage of the similarities and di_erences following an economy principle. Economy is believed to be inevitable in any cognitive action.

ONTOLOGY

The Intension/Locality Hypothesys

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We take a first step towards charting an ontological taxonomy of statements in software design. We describe three strata of abstraction in the vernacular:

- Strategic statements ("architectural design")
- tactical statements ("detailed design")
- implementation statements

We formulate two model-theoretic criteria, the Intension/Locality criteria, which divide the spectrum of design statements into a hierarchy of three abstraction classes, the Intension/Locality hierarchy:

- Non-local statements (NL)
- Local and intensional statements (LI)
- Extensional statements (LE)

In the Intension/Locality hypothesis, we contend that the distinction we observed in the vernacular is formalized (distilled and made explicit) by the Intension/Locality criteria, as follows:

- Strategic statements are in NL
- Tactical statements are in LI
- Implementation statements are in LE

Expressing Expertise or Reality? Interpretations of Ontologies for Breast Cancer

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The paper examines recent developments in the formalisation, standardisation and representation of knowledge in machine-readable ontologies in breast cancer pathology. Such a rich real-world context provides a interesting backdrop to recent arguments, for example, from Jerry Fodor about the way that "knowing how" has usurped "knowing that" as the way to understand concepts, or from Barry Smith who wishes to undermine the common characterisation of ontologies as formalisations of shared conceptualisations, and instead see ontologies as (attempts to be) representative of the underlying reality of the domain. The multiple representational levels of ontologies support several different models of processing. Hence even though ontologies are very expressive, they still instantiate the "meaning in use" approach to specifying concepts. Furthermore, in the sample domain, such concepts often have as instances images rather than textual descriptions, and therefore are arguably recognitional in character. The demands of the domain, and the practices therein, clearly determine much of the structure of the ontologies created to represent it. It is argued by Smith and others that this introduces the danger of an arbitrary proliferation of ontological concepts, and may prevent the distinction of good ontologies from bad. This may indeed be true in the general case. But examination of the goals of ontologies in use reveals a normative dimension which in actual cases reduces (if not eliminates) that danger. The paper elucidates how the meaning-in-use picture squares with the "reality" of medical science; such a reality cannot be grasped independently of medical practice. Furthermore, the semantics of the ontologies compliant to current standards are denotational, which as Fodor has argued is incompatible with the epistemic nature of their concepts. We discuss the apparent contradiction, and argue for the inevitability of compromise in the applicability of formal ontological apparatus.

The Role of Transformation Groups for the Ontology of Geometrical Objects

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Although we may ascribe to modern axiomatics the successful treatment of geometrical concepts with the least appeal to intuition, the link between mathematics and the physical world cannot and should not be denied, firstly because it reappears even in the purest process of thoughts, secondly, because of its importance in order to save the historical and psychological roots of the current geometrical methods. The problem posed here is to define the basic notions of elementary geometry (that of point and of straight line) saving both the need for rigour and the empirical genesis of mathematical objects. Felix Klein's Erlanger Program and Poincaré's booklet On the foundations of geometry give us the key notions for a plausible solution. For the first time, with Felix Klein's dissertation the concept of transformation group revealed its central role in organizing and defining different geometrical systems. It gives, for example, a precise meaning to the notion of gemetrical property by means of the theory of invariants. Moreover, Poincaré's thought-provoking observations punctualized that the concept of group could play a major role in the genesis of geometry. According to Poincaré, the mind (ésprit) is endowed with the a-priori structure of groups which is imposed upon the unstructured manifold of sense impressions, in order to give them the form of Euclidean space.
Thanks to the group of displacements we are able to abstract, from things materially different, the same mathematical object. We will show that it is possile, starting from Poincaré's considerations, to build an immanent realization of a given group. This achievement allows us to give a proper definition to our basic categories of mathematical objects, and even to retain those links between human experience and abstract theory, whose essential role for the comprehension of the development of geometry, far from being removed, must be emphasized.

Knowledge in Action.
The Use of Formal Philosophical Ontologies in Knowledge Management

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The transformation of dynamic and practical into storable and static knowledge has been seen as a core task of knowledge management (KM). However, the success of this KM conception was limited since it neglects the adaptation of knowledge to the context for which it is required. We need more dynamic and processive conceptions to close the gap. The core task consists in mediating between practical and propositional knowledge. Philosophical tradition provides famous examples how knowledge comes to the fore, e.g. in Plato's dialogue Meno. Here Socrates states that all knowledge is already within us and reasoning only brings it forth. KM has to accomplish a similar task. Knowledge must be stored in a form which is not bound to the situation from which it originates. But how can we structure context-sensitive knowledge so that it is storable in a context-independent way and in a form that remains applicable to other contexts? Static knowledge is to be defined in analytic expressions of relations. Dynamic knowledge is adapted to specific and changing conditions, related to environmental and social contexts. Knowledge must be rearranged in a context-sensitive way. "New" knowledge results from recombination of existing entities. Today in KM the view prevails that every domain entails its own fixed ontology. This view, however, prevents the efficient application of knowledge. Segregation of knowledge components using meta-structures is discussed as a possible solution. By this meta-structure we mean the representation of the relations between entities, not the representation of the entities themselves. Following the idea of formal philosophical ontology we find a considerable number of stable relation patterns. The approach combines a systematic component with the acquisition, structuring, and representation of knowledge. It is based on the assumption that objects and events do not conjoin at random but show repetitive patterns of connection.

Pragmatic Views on Ontology Integration

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Conceptualization explicitly represented in the form of an ontology enables agents to exchange meaningful information across applications by reducing the ambiguities of the meanings of the terms used for a given task. An ontology is the result of cooperatively constructing the knowledge by the group of people who are ontology designers, knowledge engineers, or domain experts. An ontology provides semantic interoperability among heterogeneous information systems by means of semantic level content explication rather than the syntactic level standardization in representing information. Recently, a large number of ontologies have been developed and are commonly used on the Web. The integration of distributed and heterogeneous ontologies is one of the basic problems in the development of techniques for the Semantic Web. Ontological interoperability is not obtained simply by making a global level common ontology that captures the mapping between different local ontologies. It is very common in the Semantic Web that concepts represented in different ontologies are mutually inconsistent.
Since a single ontology represents a model of a certain knowledge domain, the meaning of a term needs to be coordinated or negotiated across ontologies to bring together different mental models into a task domain. The process of ontology integration, whether it is carried out in the form of ontology mapping, merging, or alignment, is very similar to the process of ontology creation in the sense that both processes have communicative features. While in the process of ontology creation the human developers work together to draw a shared concept, the process of integrating ontologies involves either automatic or semi-automatic processes of semantic mapping and conflict resolution. The ontology as conceptual structure is a static model containing common assumptions shared by the community of a certain domain, and yet ontologging as conceptualization process is dynamic and involves context dependent interpretation.

Modelling Preference Change

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This paper introduces a formal framework of preference change. We develop a preference logic that is capable of representing incomplete and vague preferences and that also represents dynamic information about preferences. On the basis of this logic, we construct a comparative statics framework of preference change. A preference state is in equilibrium if it is consistent. External shocks might push the preference state out of equilibrium; our models shows how the preference state returns to equilibrium and in what equilibrium state it will end up. We identify four principles, which constrain the equilibrium restoration path: success, consistency, entrenchment, and conservatism. The external shock is modelled as an input consisting of a change command and a set of preference sentences. The input is clearly to be distinguished from causes of preference change; however, we show that our framework is capable of representing all preference change causes.

The Wonders I Would Like Intelligent Machinery to Do (for Me)

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This article is about the future role of machines in human society and evokes questions of an ethical nature in realms that traditionally remain "taboo" in short-term scientific literature. It is essential for the reader to understand that, in developing this logic, the author questions the very nature of the human being's status in the near future. Reductio ad absurdum-type approaches are commonly used to dismantle popular theories; the ultimate goal in mind here is to change wide-spread policies and practices in society with regards to the use of machinery by proposing realistic social scenarii for it. If machinery is to be fully integrated into human society, what roles do we wish it to fulfil? How social are technological artefacts to be? Moreover, the practitioners in the fields of Artificial Intelligence, Human-Computer Interaction and Humanoid Robotics are explicitly called to respond to such argumentation. The author wonders if this is the wrong way to go about dismantling their theories. Can coercing Man's fabrications of himself into the human realm do so? Refuting the approach the author uses would be an immense step forward for specialists of technology humanisation, at least in the eyes of the public, because these awkward questions are being asked by those "on the outside". Thus, it would be of utmost interest for the entire human community if those working in these highly specialised fields communicate on the topic of their ultimate research goals. Veritable social acts are invoked herein in attempts to stimulate more visionary dialogue.

Does the expression ”information society” have something to do with the scientific notion of information?

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My objective is to draw a sketch of the epistemological and methodological impacts that the scientific notion of information had on sociology and economy.
I will recall that social sciences got a real methodological boost from last two historical events: the integration of the statistical calculus of probability in their methods and the generalization of the scientific notion of information. Both of these events occurred or became an accepted fact in the midst of the twentieth century, plus or minus 25 years.
From the point of view of epistemology, however, this encounter is only significant because, and this is my hypothesis, the formalization of this notion permitted the reconsideration of the social sciences’ scientific relevance. By saying this, I mean two things:
1) It gave social scientists and philosophers a crucial argument as to how the social sciences were in fact, so they thought, possibly as formalizable as any other sciences: let’s call this the epistemic impact;
2) It was also and therefore possible to assign to social sciences a new role as the theoretical matrix of social engineering: call this the technological impact.
But all of this was possible only because society and economy were represented as receptacles of quantity of information.
I will be considered here by the epistemic impact’s analysis. I will show that when introduced into social sciences, the scientific notion of information produced not only a new type of science, but a science which could therefore stop trying to be demonstrable: this notion gave these sciences the formal argument to never have to prove anything because it was not epistemologically able to distinguish between model, facts and methods.

Exploring The Engelbart Hypotheses in Theory and Application

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Computing pioneer Douglas Engelbart has a vision of improving human communities through innovation and technology. His quest is to cultivate the relationship between minds and machines in pursuit of better strategies to communicate, collaborate, and solve compelling human problems. Inspired by 20th century visionary Vannevar Bush, Engelbart took to heart the post-World War II charge of using newly developed computing technology to create new ways with which to use information to make life better. From the first wooden mouse to his newest invention, the Hyperscope, Engelbart has been attempting to perfect the augmentation of human capabilities through the use of information technology for nearly half a century. The pragmatic results of his work are well known. Every computer today is accompanied by its mouse and monitor; nearly everyone online interacts using some form of e-mail. However, the philosophical ramifications of Engelbart's work are far less clear. The epistemological notions he posits through the concepts of human augmentation and the collective IQ, as well as Dynamic Knowledge Repositories and Networked Improvement Communities, are compelling, and have yet to be fully explored.
Two universities have joined in his exploration of the augmented collective IQ by developing and deploying a curriculum infusion project wherein students explicated then applied elements of the Engelbart hypothesis. The work presented here is a preliminary philosophical explication of the Engelbart hypothesis, an analysis of the rational and empirical ideas of which it is comprised, and a discussion and examination of the results of a full year of application of his strategies and ideas in the university classroom.
The project's history, the course plan, techniques and technologies used, and evaluation of the results will be reviewed in this presentation.

Formalising Semantic Information. Lessons from Logical Pluralism

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By introducing the notion of logical pluralism, it can be concluded that up to now theories of semantic information have - at least implicitly - relied on logical monism, the view that there is one true logic. Adopting an unbiased attitude in the philosophy of information, we ought to ask whether logical pluralism could entail informational pluralism. The basic insights from logical pluralism and their implications for a theory of semantic information should therefore be explored. First, it is shown that (i) the general definition of semantic information as meaningful well-formed data does not favour any logical system, (ii) there are nevertheless good reasons to prefer a given logic above some others, and (iii) preferring a given logic does not contradict logical pluralism. A genuine informational pluralism is then outlined by arguing that for every true logic the logical pluralist accepts, a corresponding notion of semantic information arises. Relying on connections between these logics, it can be concluded that different logics yield complementary formalisations of information and informational content. The resulting framework can be considered as a more versatile approach to information than its monist counterparts.

Some Assumptions about Problem Solving Representation in Turing's Model of Intelligence

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We explore some idealizations that may lead to model methodical intelligence with Turing Machines (TM's). Often the specification of TM's leaves unexplained the intuitions behind positing those characteristics and not others. Our goal is to revisit the possible assumptions of the model and to ponder some considerations in favor or against adopting it. In this paper we deal with the assumptions about representation in general and about the specific kind of representation offered. The assumptions about method are the focus of future work.
Turing made no explicit contention in 1936 about TM's being a model of intelligence in general. That changed in 1950 when he tried to analyze the notion of thinking machines. Turing's ideas are remarkably coherent in these two papers. Our exegesis tries to shed light on both essential and non-essential principles behind the TM's model. A principle is "essential" (1) if its removal from the model changes the computational power of the model. It is also essential (2) because its removal changes the nature of the model whether it changes its computational power or not. In the first sense of "essential", some of the principles can be removed without affecting the computational power of the model, but there are others whose removal opens the door to models with greater, lesser, or just plain different expressive and computational capability. In the second sense of "essential", while some principles are of a cosmetic nature or redundant, some can change the nature of the model to a degree that their presence might force us to change our views about the adequacy of the model to our intuitions about intelligence and mechanical problem solving.

P=NP
— & —.*

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We offer a philosophical argument that we claim settles the famous P=?NP problem. Notice: philosophical argument, not a mathematical one. Nonetheless, we do see the argument as a proof, one expressible only in logics more powerful than those within which most of those working on P=?NP are imprisoned.

.*We're greatly indebted to — — for many valuable discussions about the P=?NP problem and digital physics. Though the two arguments herein establishing P=NP are for weal or woe —'s, —'s astute objections catalyzed crucial refinements.

Can Knowledge be an Immutable Data Type? The Limits of the Model-Theoretic Approach

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Knowledge Management has become a sexy topic in information technology circles. Unlike its close cousin Data Management however, Knowledge Management is at present largely devoid of any philosophical foundation. Much of the work carried out within this field I argue relies upon a computational method of representation that falls far short of being capable of adequately representing knowledge. This paper examines the semantic or model-theoretic view that emerged as a result of work by Tarski and Carnap amongst others subsequently laying the foundations of modern database theory. Attempts to "model knowledge" under this foundational framework are fated to treat knowledge artifacts (if indeed we admit such things into our ontology) as immutable data types. We examine the validity of this approach and examine some of the reasons why it is inadequate for knowledge representation.

Toward Anti-Formalist Computer Science

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The Lakatos-Feyerabend-Kuhn methodology of scientific research programmes (LFK) theory is applied to disprove formalist philosophy of computer science (CS). The LFK theory conforms to the development of science during the 20th century by insisting that science and philosophy of science must be studied by analyzing research programmes as case studies in their historical context. The formalist CS research programme and its un-sceptical acceptance of the artificial intelligence (AI) research program are disproven using the mathematical and philosophical results of the LFK programme. The paper shows that AI is a degenerating research programme in the LFK sense and then continues by disproving the core claims of formalist CS. The following negations are proven: 1. Probablistic analysis can not be applied to scientific theories because all theories of knowledge have zero probability. A result of this analysis is that quantum computation is nothing more than study of a particular type of imagined computational oracle. 2. There are other possibly superior alternatives to the NP completeness definition of computational hardness. Characterization of computational hardness is a 'quasiempirical' scientific problem following Lakatos' definition of 'quasi-empirical'. 3. Formal theories of computer programming are wrong and Feyerabend style 'anything goes' methods are superior. The paper concludes with a discussion of why it has been so difficult to disprove formalist CS even though formalist CS fits the LFK model of a degenerating research programme.

BIOLOGICAL INFORMATION, BIOCOMPUTATION

Bringing Physiology back into the Life Sciences

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Over the last 15-20 years, much of biomedical research has been focused on the genetic and genomic aspects of living organisms. As the DNA sequence is mapped for more and more organisms, the next step is to bring understanding to the mRNA and protein expression patterns that are being studied.
Therefore, both classic and novel physiological models are necessary to assess functional aspects linked to genes and gene products. In general, we need to tackle the complexity of biological systems in ways that favor our capabilities to solve these problems, and we need to tackle the issue of translating such biological knowledge from the bench to the bedside.
Finally, for true understanding of human disease it is essential to include human experiments and data as early as possible.

How to Deal with Granularity?

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The goal of this paper is to explore the phenomenon of granular structure of biological organisms (also called 'levels of complexity or biological organization') and to indicate a possible way to represent this structure formally for purposes of reference ontology. By 'granular structure of organisms' we mean the fact that the smaller elements, such as molecules compose bigger, such as cells, which in turn still bigger, such as organs, etc up to the level of the whole organism. The fact that organisms are of such structure has been known already for a long time, although it seems that from the formal point of view not much attention has been paid to this. The paper is divided into three sections (1) description of applied formal ontological framework; (2) reflection on levels of granularity in anatomy; (3) indication of how a formalization of granularity may look like. The goal of understanding granularity is not only theoretical but has its practical applications as well, especially in the area of bioinformatics

Derivation and Demise

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Much recent work in biological ontology is marked by a series of shortcomings derived from a failure to pay attention to principles of good practice in the formulation of terms and definitions. Reform efforts currently under way under the auspices of the Open Biomedical Ontologies (previously: Open Biological Ontologies) Consortium (OBO) are designed to rectify these shortcomings. As part of these efforts in B. Smith et al.: 'Relations in Biomedical Ontologies', forthcoming, a suite of ten relations is proposed for use in the construction and maintenance of biological ontologies in the future. In order to be able to use automatic reasoning tools for biomedical ontologies we have to establish the meaning of the proposed relations in an unambiguous and rigorous way. One of these is the relation derives from as in 'a zygote derives from the fusion of an egg cell and a sperm'. The paper presents a formal account of derives from.

Information Theory, Error Correcting Codes, and the Living World

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The conservation of genetic information through the ages can not be explained unless one assumes the existence of genomic error-correcting codes, as we did in earlier works. Shielding by phenotypic membranes does not protect the genomes against radiations. Only means intrinsic to the genome itself can do so. Error-correcting codes are by-products of information theory. They achieve reliable communication over unreliable channels, so paradoxical it may look. They are among the most powerful tools available to communication engineers, whose experience constitutes a strong experimental proof f their efficiency. As a subsidiary hypothesis, we assumed moreover they take the form of `nested codes', i.e., that several codes are combined into a layered structure which results in an unequal protection: the older and more fundamental parts of the genomic information are better protected than more recent and less essential ones.

Based on these hypotheses, fundamental results of information theory explain basic features of the living world, especially the discreteness of species and the possibility of a hierarchical taxonomy. They account for some yet unexplained facts, e.g., that life proceeds by successive generations, as well as the trend of evolution towards complexity. Also, the saltationist vision of evolution is strongly supported. Trying to identify the hypothesized genomic error-correcting codes, we were led to the further hypothesis that the many physical, steric, chemical and linguistic constraints to which the DNA molecule and the proteins for which they code are submitted act as `soft codes' which provide the necessary error-correcting ability. It turns out that we then obtain a picture of the living world which closely resembles the `organic codes' described by Barbieri although he arrived at this concept by completely different ways.

This paper is intended to some remarks of methodological or epistemological character on the way information theory and error-correcting codes can help understanding the living world. That they explain biological facts left unexplained by today's biology seems to validate our hypotheses, but the direct experimental identification of genomic error-correcting codes still lacks. It would obviously require the active collaboration of practicing genetists.

Biological Data-Based Actomyosin Complex Detection

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This paper describes that actomyosin complex particles are automatically detected. Myosin is the best studies molecular motor. Information on the myosin bound to actin can be obtained using cryo-EM. Since actomyosin complex shape is complex, its feature extraction is very difficult. We propoe a new approach which combines Gabor feature selected by AdaBoost with SVM classifier to detect actomyosin complex particles automatically. The automatic detection system is made up of two major parts of three stages cascade of classifiers and SVM. In the cascade, the weak classifier is a binary classifier and AdaBoost is to select a few important features, which reduces input vector representation for training SVM. Three stages cascaded classifier is to retain information about the continuous outputs of each feature detector rather than converting to binary decision. The second part is composed of SVM that is used for the final classifier to implement binary classes.

Actomyosin image resolution in cryo-EM is 1.72Å/pixel, size is 2048×2048 pixels with 16bit gray level. We design a 210×210 pixels window, which are rotated at 45 degrees increments to obtain actomyosin images totaled up to 1450. Actomyosin particle

detector window is scaled to 42×42 pixels as sub-window using sub-sampling approach. Actomyosin particle feature is represented using Gabor filter banks at eight orientations and five spatial frequencies. A total Gabor filter features selected by AdaBoost procedure are 215. Experimental results show that the detection rate achieves 95.62%, the false positive rate is 1.79%, the false negative rate is 4.42%, and a total rate of 97.28% of examples that were correct classified. Compared with three ROC curves, Ada-SVM is best classifier. Our approach can extract asymmetrical particles and a variety of irregular particles. Also, this approach represents progress which macromolecule particles in cryo-EM image are detected automatically.

Functions and Prototypes

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Bioinformatics has long recognized that it needs (1) a definition of 'function' and (2) a way to represent degrees of functioning and malfunctioning. A major obstacle to (1) is that the term 'function' currently refers to myriad notions, many of which are incompatible; the term must be disambiguated by identifying and defining each of these notions individually. An obstacle to (2) is that there is no clear standard by which degrees of functioning can be measured. This paper presents a framework within which both of these problems can be addressed. It will address (1) by offering a means of disambiguating each of the notions conflated within the term 'function'; it will address (2) by offering a theory of prototypes as the metaphysical basis for a standard according to which degrees of functioning of each kind can be measured objectively.

A Biologically Inspired Framework for Critical Infrastructure Protection

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The purpose of this work is to develop an autonomic risk management framework capable to prevent, identify and respond in critical time to threats. Our focus is on protecting critical infrastructure (e.g. public utilities) which vitally depends on network and information security. As solution we propose a holonic Cybersecurity system that unfolds into an emergency response management infrastructure capable to react in due time to unknown and new kinds of attacks/threats. The system can adapt to its changing environment through its self-organizing capability which embraces all the desired attributes of autonomic computing (AC). Mimicking the way immunity works in biological organisms the system can dynamically adapt to embrace new risk situations and can dynamically create and learn new risk models as it encounters new risk situations.

Irreducible Complexity and the Problem of Modelling Abductive Reasoning

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Computational modelling of global cognitive processes, such as abductive everyday reasoning, has not been successful. This article re- views these problems and concludes that the problem lies in the phenomenon of complexity, which is discussed both from the perspective of computational complexity and algorithmic information theory (Kolmogorov compexity). A hypothesis is formulated and discussed which states that these problems are due to the fact that human behavior is, in relevant aspects, an algorithmically irreducibly complex phenomenon, not subject to complete reduction to few principles, rules, learning algorithms, homogeneous networks, emergent properties, or other computational tricks, underlying much of the current computational theorizing in cognitive science. Instead of simulating global cognition, alternative approaches are discussed, such as evolutionary and genetic algorithms, the method of more generous abstraction, nonreductive science, and the theory which explains abductive everyday reasoning as a product genuinely complex, heterogeneous and narrowly constrained process. The biological source and nature of irreducible information is investigated and it is concluded that there are several potential sources of information/entropy that could explain the phenomenon, such as adaptation, genetic and epigenetic sources, biological constraints, learning-by-rote and even physical constraints. According to this view, the structure of the brain is reorganized or `crystallized' from preexisting information rather than created from nothing. Finally, because of the importance of complexity and the uncritical and often metaphorical use of the term, and because we often lack the proper tools to deal with the phenomenon, it is suggested that a more rigorous philosophical study and framework of complexity is needed to understand the phenomenon in connection with natural systems and empirical science.

Networks and Information: Explanatory Arguments in Contemporary Biology

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Network representations of biological function invoking genes, RNA, proteins, signalling molecules and metabolites, have introduced an articulation of dynamical complexity in the description of fundamental biological systems. Earlier characterisations of the "central dogma" in molecular biology – that information flows from the gene to the protein, nucleus to cytoplasm – have often been extended to provide gene-determined explanations. The contemporary articulation of causal influences of components "downstream" of the gene in this traditional view have opened up the notion of information flow, and a varied toolbox of quantitative methods are now being invoked to pose questions of biological systems and models. This paper will look at some of the explanatory roles that properties of network based characterisations are being made to fulfill, and explore the conceptual traces these techniques carry from the more theoretical-mathematical practices that engineering and physical sciences where they have been traditionally used.

Biosemiotics

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Biosemiotics encompasses all living systems from the cell, over bacteria, fungi, plants and animals to humans as sign producers and interpreters. Signs are the basic units for the study of life. Thus biosemiotics transcends the semiotic threshold between man and the rest of the world that Umberto Eco formulated. Of the two main paradigms in semiotics, Saussurian semiology and the Peircian semiotics, it is mostly Peircian semiotics that has been used to developed biosemiotics because it has a theory of signification of non-intentional signs. Biosemiotics is already prefigured in Jakob von Uexküll's Umweltlehre , which Thomas Sebeok fruitfully used to found biosemiotics. Philosophical biologists in Copenhagen and Tartu have influenced the further development of biosemiotics. They see living systems from cells to humans defined by interactions between a digital code in the gene or genotype and an analogue in the whole individual or phenotype. The gene is a code for memory and self-representation the individual living body is a code for action and interaction with the real world and its ecology. Thus life appears to be a communicative interplay of different types of self- and other- descriptions carried by molecules. Biosemiotics is further developed in Cybersemiotics to include theories of computers and embodied sign- and language games.

A Unified Theory of Information as Transdisciplinary Framework

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Information seems to be as fundamental a building block of the universe as matter and energy is. So far, however, there is no common agreed-upon concept of information.
There is still a deep cleavage between the so-called two cultures of science and technology on the one hand, and the humanities on the other. The first is characterized by a technologically circumscribed rationality The second is characterized by a humanistic rationality which is ignorant of the field of science and technology.
They express certain ways of thinking which are characterised by how they relate identity and difference:

either the different sides are considered identical, that is, either side of the difference may be regarded as the base of identity; hence one way of thinking establishes identity by eliminating the difference at the cost of the differentiated side, it reduces the differentiated side to the undifferentiated one what is known as reductionism; another way of thinking establishes identity by eliminating the difference at the cost of the undifferentiated side, it takes the differentiated side as its point of departure and projects (extrapolates) from there to the undifferentiated one and may be called projectionism;

or the different sides are considered different, that is, all relationships between them are abandoned (they are dichotomised); this way of thinking establishes the difference by eliminating identity; it dissociates both sides of the difference and treats them as disjunctive; this is what dualism (pluralism) is about;

or they are considered to be both identical and different so as to establish identity in line with the difference; this way of thinking integrates both sides of the difference and differentiates the identical at the same time; it is a way of thinking that is based upon integration and differentiation and may be termed dialectic as it includes opposites.

Computing sense and reference

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Model generation offers various techniques for computing the referential properties of discourse utterances. This paper investigates the analytic consequences of various conventional assumptions accompanying the application of model generation techniques to various referential expressions, incl. proper names, definites and polymorphic nominals. Our first investigation is of the unique name assumption. The unique name assumption in model generation refers to the habit of translating proper names as constant terms and interpret them "as themselves". Three possible objections to the unique name assumption are raised. The first objection is trivial and addresses quite specifically the variation in naming of humans, artefacts and places. The second objection is that in special cases substantially different names with quite different connotations apply to the same individuals. Finally, a third objection is that the same name, if modified appropriately, may refer to different discourse referents even within sentence boundaries. It is demonstrated that while at least two of these objections can be resolved without abandoning the unique name assumption, the assumption complicates the theory considerably. In other words, the unique name assumption can be abandoned on grounds of efficiency. A simpler translation of proper names is into Russellian definite descriptions. The application of such descriptions to definite noun phrases is investigated. It is demonstrated that the usual application is empirically inadequate, but that the inadequacy is easily repaired, if a clear distinction between familiarity and uniqueness is made. The final phenomenon which is investigated, is polymorphic nominals. If model generation is applied to polymorphic nominals, the minimal model-theoretic interpretation will correspond to the interpretation on which only the necessary assumptions about the nature of their referents are presupposed. In addition, automatic disambiguation falls directly out of most model generation techniques. The philosophical question is of course how to interpret the structure used to represent polymorphism. I propose to represent polymorphism in terms of qualia structure and to interpret this as an extended notion of sense.

Information Structure Representation and Extraction from a Corpus of Patient Data, Using an Ontology

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We propose a methodology to model the information structure for its extraction from any medical text. We experiment this extraction in a corpus that represents the information system of a specific professional activity in the hospital pharmacy.
The model of the information structure presupposes we know what are the constraints of the information system on the symbolic entities (in a way to distinguish the information structure to any sentence description). In a way to determine these constraints, we propose to model the information process by the information flow: we represent in this way how any fact in the body of the patient is symbolised, conveyed and represented into a text.
The information flow characterizes only the constraints of the information on the linguistic entities and structures. But the information is linguistically a referential semantic object: it's the representation at distance of a new fact in the world in the frame of a text that accepts this information. Then the model of the information structure represent how the meaning of a sentence is specified by the constraints of the information flow.
But the information structure is systematically recognized and interpreted in the context of a text: it's also the last object of the information system. Then we consider the text as a contextual frame to model the recognition and the extraction of the information structure.
A text can't be considered only as a linguistic object in a professional and information context: it's an implemented (or externalised following situated and distributed cognition) ontology. The updated text articulates the ontology of the patient body and the referential dimension of the information.
At last, The information flow allows the articulation of an ontology and a semantic precisely on the question of the information structure. We unify the model of the information structure by the definition of five primitives. A sign representation allows both the characterisation of the structure and of each of its components.

Views of Text-Meaning in Computational Linguistics: Past, present, and future

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Three views of text-meaning compete in the philosophy of language: objective, subjective, and authorial. Computational linguistics and natural language processing have traditionally ignored the competition and implicitly embraced all three, and rightly so; but different views have predominated at different times and in different applications. Knowledge-based systems of the 1980's emphasized the subjective view: meaning and interpretation depended on the system's own knowledge-base. Dialogue systems of the 1990's emphasized the authorial view: meaning was in the head of the user, as ``author'' of its inputs, and the system's job was to deduce what that was. Contemporary applications, however, mostly take the crudest view: meaning is objectively ``in'' a text. But underlying these divergences is the (untenable) tacit belief that in a ``complete and correct'' language-understanding system the three views would coincide. In the more-sophisticated applications of natural language processing that are now on the horizon, however, analytic Web-search and question-answering tools will seek to match meanings rather than merely matching strings. This will require that the views of text-meaning be made more explicit and distinct, and that the in-text view be subordinated. As the computer takes on the user's purpose, it must also take on the user's subjective views, and try to decide what a particular text means subjectively for that particular user in the context of that user's specific purpose. And sometimes, the user's purpose includes determining the author's intent. Thus the requisite view of meaning becomes part of the user's problem statement. Both these views of meaning, but especially the authorial view, require, among other things, an ability to determine what the author could have said but didn't --- a Saussurean perspective on communication. And this, in turn, requires a sensitivity to linguistic nuance, for which computational mechanisms need to be developed. I will briefly describe work with Diana Inkpen on a lexical knowledge-base that differentiates near-synonyms.

A.L.I.C.E. – an ACE in Digitaland

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Artificial linguistic Internet computer entity, A.L.I.C.E. is considered head and shoulders above other artificial chatting entities, ACE in digitaland. Three times winner of Loebner's annual instantiation of Turing's Test for machine intelligence in 2000, 2001 and 2004 judged most human-like machine, A.L.I.C.E. was additionally gold medal champion in 2004, for most knowledgeable programme in ChatterBot Challenge and won bronze medal for most popular ACE.

As a modern Eliza, A.L.I.C.E appears as a dark-haired blue-eyed female avatar, eperson. The programme's architecture contains a combinatory scheme including keyword matching, spell checker, grammatical parser, random sentence generator and case-based reasoning or next-neighbour classification. These features allow A.L.I.C.E. to correctly associate the sense of word 'live' to produce response about residential location when asked "where do you live?" and ask question about "subject" being "studied" when presented with "I study a lot" by Judge 1 in Loebner's 2004 Contest. However, as a discourse model, discourse features such as information exchange, disclosure of intentions, goals and desires are minimally exhibited in A.L.I.C.E.'s conversations.

A.L.I.C.E. type programmes appear on e-commerce Internet sites in a variety of roles; their use will continue to grow as more companies see their deployment as enhancing human-computer interaction while building brand awareness and increasing sales. ELBOT, Loebner's 2002 and ChatterBot's 2003 winner, is the underlying technology behind UK e-bank Cahoot's "any questions" query system, and Swedish furniture store IKEA's virtual customer service agent, recently considered by NY Wall Street Journal as most useful ACE.

As seen in both the Loebner Contests and ChatterBot Challenges, in unrestricted domains these programmes have a long way to go before they are able to constrain their artificial linguistic productivity to that which is meaningful and be deemed intelligent. Nonetheless, in single specialised e-domains ACE are succeeding and with speech-recognition augments will afford natural human-machine interaction.

Language and Social Interaction: Re-Discovering Small Talk

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The development of language engineering technology already provides a range of sophisticated automated telephony services. Arguably for the foreseeable future, the role of natural language processing in mediating human-computer interaction will be focused on a similar range of task oriented transactions. From a paradigmatic perspective, the significance of task oriented dialogue analysis is well established in computational linguistics research and Artificial Intelligence. The primacy of dialogue as information exchange, rather than its social instrumentality, is the dominant research modality. We argue that this trend needs to be acknowledge and redirected through recognising the social role of language in future computational initiatives. Such redirection is essential if socio-affective agents are to warrant any credibility.

What do we Evaluate when we Evaluate Word Spaces, and what *Should* we Evaluate in Order to Evaluate them?

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It has become increasingly popular to use vector spaces generated from distributional statistics as a representation of word meaning. The underlying structuralistic hypothesis is that the distributional profiles of words are symptomatic for their semantic content, and that a geometric representation of these profiles is cognitively plausible. Both the distributional hypothesis of word meaning and the geometric representational scheme have proven their mettle in many different experimental settings, with a wealth of publications reporting exceptional results and arguing for the viability of the approach. It is, to say the least, an active area of research. Even so, neither the reliability nor the validity of the evaluation methodologies have received much attention. This is remarkable since it is anything but obvious how to evaluate models of word meaning. To make matters even worse, it is not even obvious what ``meaning'' means. Conceptual opaqueness is all too often neglected in favor of experimentalism within the field of computational linguistics. However, when neither the conceptual nor the experimental basis is scientifically sound, one may seriously question the validity of the reasearch. This paper does not attempt to solve the conceptual riddle about the meaning of ``meaning''. Neither does it problematize the distributional hypothesis nor the geometric representation. Rather, it problematizes the evaluation methodology. The following question constitutes the central theme of the discussion: How can we scientifically determine whether the geometric representations really do contain information about word meaning?

Symbolic Machine Learning: A Different Answer to the Problem of the Acquisition of Lexical Knowledge from Corpora

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One relevant way to structure the domain of lexical knowledge (complex terms, or relations between lexical units) acquisition from corpora is to oppose numerical versus symbolic techniques. Numerical approaches of acquisition exploit the frequential aspect of data, and use statistical techniques, while symbolic approaches exploit the structural aspect of data, and use structural or symbolic information. Methods from this former approach have been widely used and produce portable, robust, and fully automatic systems. They provide however poor explanations of their results, and may have difficulties to grasp very specific relations. The symbolic approach groups two strategies. The first one is the symbolic linguistic approach, in which operational definitions of the elements to acquire are manually established by linguists —usually in the form of morpho-lexical patterns that carry the studied terms or relations—, or by a list of linguistic clues. However, when such patterns or clues are unknown, but examples of elements respecting the target terms or relation are known, techniques from the second strategy of this symbolic approach can be used, i.e. symbolic machine learning (ML) methods. This facet of this approach, far less known and employed, is just beginning to appear and widen in the natural language processing community. The aim of this paper is to point out the interest of such techniques, and to show how they can be used to infer efficient and expressive extraction patterns of complex terms or lexical relations from examples of elements that verify the target relations or the form of the terms. However, these techniques are often supervised, i.e. require to be (manually) fed by examples. We also explain that one method from each of the numerical and symbolic ML approaches can be combined in order to keep advantages from both: meaningful patterns, efficient extraction and portability.

Computational Linguistics as an Applied Science

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An applied science is opposed on the one hand to an empirical science and on the other to technology. It shares with the former its concern for explanation and with the latter its concern for solving practical, real-life problems. A prototypical example is medicine, where the purpose of research activity is both to find cures and to explain how they work. Whereas computational linguistics (CL) can also be pursued as an empirical science or used as mere technology, it is most interesting as an applied science. As an applied science CL is confronted with four basic questions about the problems to be solved: • Problem identification: What is the range of acceptable input and what is the type of output to be produced? • Evaluation: How can it be determined that the system produces the correct output and thus solves the problem? • Problem decomposition: How can the problem be analysed into components? • Knowledge selection: Which types of knowledge should be used to solve the component problems? It is important to address the questions in the order they are listed. The history of MT shows that when the question of knowledge selection is given priority over the others, there is a serious risk of ending up with a non-well-formed problem. The way explanation works in CL is largely parallel to its role in medicine. The basis of explanation is a model of communication applied to a particular situation. The object of explanation includes the wellformedness of the problem selected, its analysis in terms of the model, and the adequacy of the solution method. As a consequence, statistical methods have a mainly heuristic function.

Automatic Conversion of Text into Images

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We describe an architecture for systems that create automatic images from text. Although prototypes of such systems have been implemented in a few previous projects, none of them examined the conceptual foundations of this process. We investigate the cognitive and knowledge representation issues that are central to the task, and propose an architecture that reflects these considerations. In addition, we describe how this architecture was implemented in Carsim, which is a prototype system for traffic accident reports written in Swedish. We finally present a user study to evaluate this system.

ETHICS

Homo-technius: an Interconnected Evolution

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This paper considers how trends and fashion in computing technologies might influence a global system of computing ethics. We propose that a new evolution of the human-species, Homo-technius, has occurred. An evolution spawned by the information and computing technology era that we now live in. We examine how Homo-technians, across differing cultures and continents use fashionable technologies to facilitate their life-journeys. We also examine how this newly evolved human species is currently able to apply cultural and ethical systems to the use of computing technologies, with little or no training, either in the use of the technology, or of any computing specific ethic or code of practice. We also consider the convergence, if any, of cultural behaviours and value systems into a system of global computing ethics, and by doing so test theories of future computing ethical systems predicted by Deborah Johnson and Krystyna Górniak-Kocikowska and discuss both the relevance and desirability of their proposals. This paper concludes by proposing that it is not in the human interest for local and cultural ethical systems to converge in to a single, or global system of computing ethics. We, instead, propose that human 'being' is enriched by the acceptance of, and tolerance for, divergent cultures. Our future, as Homo-technians, lies as a colourful and culturally-diverse cyber-society that solves computer-ethical policy vacuums using local ethical systems.

Autonomy and Morality in DRM Anti-circumvention Law

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In this paper, we examine the moral propriety of laws endorsing and encouraging the deployment of digital rights management technologies, or DRM. DRM provides self-enforcing technical exclusion from pre-determined uses of informational works; such technical exclusion may supplement or even supplant intellectual property laws that penalize certain unauthorized uses of informational works. The use of DRM has been subsidized by laws prohibiting both disabling of technical controls and assisting others to disable technical controls. To date the public debate over deployment of DRM has been almost entirely dominated by utilitarian arguments regarding the social costs and benefits of this technology. We argue that a deontological analysis, focusing on the autonomy of information users, deserves consideration. DRM shifts the determination of information use from users to producers; users are denied the choice whether to engage in use or misuse of the technically protected work. Adopting a moral framework previously promulgated for justification of criminal punishment, we argue that this shift in determination implicates legal recognition of the individual as an autonomous decision maker. State sponsorship of DRM in effect treats information users as moral incompetents, incapable of deciding the proper use of information products. This treatment of information use can be distinguished from other state sponsorship of technological exclusion, such as the use of locks on physical property, due to the necessity of informational works to human flourishing. This analysis militates in favor of legal penalties that recognize and encourage the exercise of autonomous choice, even by punishment of blameworthy choices, rather than the encouragement of technology that limits the autonomous choices of information users.

Ethical Problems in the Relationships of PhD Students and Supervisors: A Computer Science Perspective

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Traditionally, research paradigms and methods are passed on from teachers and supervisors to PhD students as they undergo their doctoral studies. At the same time, the PhD student/supervisor relationship is a highly vulnerable construct, subjected to a number of conflict-generating situations. The research area of computer science is a relatively young community, whose methods, paradigms and traditions are not yet fully developed. This puts high demands on computer science research supervisors to create a sound local tradition of research, both as far as methodology and ethical norms, and supervisory behavior go. This paper discusses the ethical problems of the PhD student/ supervisor relationship, and will especially highlight the problems that are visible in the computer science research community.

Internet Search Engines – a Case for Ethical Overhaul?

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This paper addresses the issue of Internet search engines. After a discussion of current practice, it seeks to determine appropriate guidelines for their construction and operation. It concludes by looking to what may potentially happen if clear ethical standards are not urgently applied to the management and use of Internet search engines.

The Promise of E-Democracy. Why the Internet May Challenge Politics

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Recently the impressive growth of the Web, and the Internet in general, has been considered as a promise that may both challenge and boost our representation of democratic institutions. It is well known that modern democracies are based on the possibility to control and even replace who rules by the force of the best arguments. More generally, the control of the government, and the effectiveness of democracy, is possible, if the citizens can access information. Hence, the promise of the Internet mainly relies on the fact that people may more freely access information, because it seems it cannot be controlled or manipulated by the political power.
In the first part of this outline we will depict a cognitive framework to deal with the relationships between Internet and democracy. We shall show that Internet, as an information technology, can be considered as a cognitive and moral mediator; it can provide stories, texts, images, combined with sounds, so that the information fosters not only a cognitive, but also an emotional and moral understanding. In this sense, the Internet represents a kind of redistribution of the moral effort through managing objects and information to overcome the poverty and the unsatisfactory character of the options available.
In the last part we will illustrate that Internet, as a moral mediator, may enhance democracy in two respects. First, it affords civic engagement and participation; second, it allows people to face different sources of information so that almost everyone can verify and test the information delivered by traditional media.

Moral Consciousness as a Base for Computer Ethics

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The objective of this paper is to analyze the concept of consciousness from an ethical perspective. The world in which we live today faces an unparalleled crisis regarding human ethical values. Today in spite of having a greater quantity of values, the quality of those values has diminished. The real problem resides in the meaning or the sense that we assign these values and that those values are understood depending on certain contexts. This kind of problems is characteristic of the Postmodern Age in which the only certainty is uncertainty. This is due, in part, to a lack of understanding about what the mankind is. In order to better comprehend mankind, philosophical anthropology plays a key role. Using this perspective it is necessary to consider the philosophical anthropology of Emmanuel Levinas which is in opposition to Jean-Paul Sartre's existentialism.
In addition, it is necessary to propose moral progress as a viable alternative -to the techno-scientific progress- that serves as a base as much for our discipline, as for our humanity. With this idea in mind, the article analyzes the consciousness from the Latin American conception. Furthermore, because of the Masters of Suspicion, we have changed the way in which we have changed the way in which we think about how the consciousness works.. In this way we will discuss the role that the deontological approach has to play in computer ethics and in computer scientists.
Finally, through the metaphor as tribunal or judge, we will answer the questions:

- Which role is culture playing in the moral development of consciousness?
- Is really possible to develop an artificial moral consciousness as it was considered in E-CAP 2004? If so, are we preparing humanoid robots as our successors?
- What are the impacts that moral consciousness has as a base of computer ethics?

Object-Oriented Programming, and Computer Ethics

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What James Moor famously described as "policy vacuums" due to the ICT revolution have challenged our traditional ethical theories, and strained our conceptual resources. However, supplying philosophers with ethical challenges is not the only way in which computer science can be of assistance to the development of ethical theories. In this paper I will argue that terminology based on Object-Oriented Programming (OOP) can be of help when approaching ethical challenges – especially challenges within the field of Computer Ethics. This claim will be exemplified by trying to reinterpret the Kantian conception of indirect moral duty in OOP terms, in order to underline the importance of assessing the properties and functions of the objects we are acting towards. This focus on the properties of the objects we are acting through or towards, rather than the agent or action itself, is a furthering and defense of

some central insights in the Information Ethics of Luciano Floridi, and the Disclosive Computer Ethics of Philip Brey. I will defend the thesis that choosing an informational level of abstraction framed in OOP terms, is important in order to avoid over-simplified assessments of Human-Computer Interaction. The central insight borrowed from Object-Oriented Programming is the way of dealing with problems by asking in what ways an information object can react to, modify and redirect messages received from a different Information Object.

Securing Information System Projects Ethically: Arguments For A Professional Ethical Maturity Model

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Many of the attempts to find solutions for the deficiencies in the development and implementation of an Information System (IS) have been concentrated on project management, models, methods, techniques, and business demands, but little or none on ethics. Some of the deficiencies are questions of ethics but the professional codes of ethics is not enough because some of the problems are out of scope of the individual IS developer. The relationships between the parties in an Information System Development (ISD) project are also complicated which makes it even more difficult. Everyone, the supplier, the client, and society involved in an ISD project needs therefore to be aware of and take responsibility for their part of the ethics both in the process and the outcome. To help out with the awareness of ethics in IS development and implementation there is an incitement to develop a Professional Ethical Maturity Model (PEMM). The introduction of PEMM could be seen as an attempt to ethical securing of ISD projects on different levels in the IS developer organization.

Artificial Intelligence and Moral Intelligence

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We discuss in our paper if a code of conduct implemented in machines must/will be a moral code, also the presupposition that implementation of a moral code needs a specific form of human and artificial intelligence, not just abstract intelligence, and we present three working hypotheses for its implementation. Advanced information systems which will use knowledge, evaluation and decision based AI techniques can/must be treated as 1- individual entities (will be complex, specialized, autonomous or self-determined, even unpredictable), 2- entities endowed with diverse or even multiple intelligence forms, like moral intelligence, 3- open and even free conduct performing systems (with specific, flexible and heuristic mechanisms and procedures of decision), 4 – educable, not just teachable systems, 5- entities with "lifegraphy", not just "stategraphy", 6- equipped not just with automatisms but with beliefs (cognitive and affective complexes), 7- capable even of reflection ("moral life" is a form of spiritual, not just of conscious activity), 8 – elements/members of some real (corporal or virtual) community, 9 – cultural beings: free conduct gives cultural value to the action of a "natural" or artificial being. Implementation of such characteristics not necessarily supposes efforts to design, construct and educate machine as humanlike being. Human moral code is irremediably imperfect: is a morality of preference, of accountability (not of responsibility) and a morality of nonliberty, which can not be remedied by ethical systems invention, ideal values circulation and ethical (even computing) education. But such an imperfect morality needs perfect instruments for its implementation: applications of special logic fields (logic of preference and logic of belief); efficient psychological attainments (theoretical and technical) for endow machine not just with intelligence, but with conscience and even spirit; comprehensive technical means for supplement/substitute objective decision with subjective one. Machine ethics can/will be of highest quality because will be derived from sciences, modeled by techniques and realized by technologies. If our theoretical hypothesis about a specific, moral intelligence, needed for implement an artificial moral conduct, is correct, some technical issues appear, but the following working hypotheses are possible: structural, functional and behavioral. The future of human and/or artificial morality is anticipated.

Expected Influence of Applied Ethics on Product Development Processes

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Product development efficiency and effectiveness is depending on a process being well executed. The actions of individuals included in the processes are influenced by the ethical and moral orientations that have been selected by each individual, whether this selection is conscious or not. This paper describes different ethical choices and the expected effect they may have on the development process exemplified by the product integration process for software products. The different frameworks analyzed are utilitarianism, rights ethics, duty ethics, virtue ethics and ethical egoism. Our conclusion is that the adherence to specific moral frameworks simplifies the alignment of actions to the practices described in product development models and standards and supports through this a more successful execution of product development projects. This conclusion is also confirmed through a comparison between the different directions and several codes of ethics for engineers issued by organizations such as IEEE as these combine features from several of the ethical directions.

LEARNING

Testing Reasoning Software. A Bayesian Way

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Is it possible to supply strong empirical evidence for or against the efficiency of reasoning software?
There seems to be a paradox concerning such tests. On the one hand, acceptance of reasoning software is slow. There seems to be room for skepticism among decision makers and stakeholders concerning its efficacy. On the other hand, teachers-developers of such software (the present author being one of them) think the effects of such software is obvious.
In this paper, I will show that these two strands are compatible. Both extremes can be true, namely if we assume (1) that the testing methods differ, (2) that the facilities of observation differ and (3) that the testing relies on contextual assumptions. In particular, I will show that developers of reasoning software can, in principle, know the efficacy of certain design solutions while other decision makers find themselves lacking evidence for efficacy.

Development Environment for Adaptive Systems

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Adaptive systems constitute an emerging interdisciplinary field that deals with distributed, nonlinear systems. They complement present engineering design principles and are suitable to interface directly with the real world. When applied correctly, such systems can considerably outperform more traditional methods. Adaptive systems can be applied in many important engineering applications, such as signal enhancement, noise cancellation, classification of input patterns, system identification, prediction, and control. The main characteristic of adaptive systems is their ability to dynamically construct a model. Instead of being built a priori from a pre-existing model, adaptive systems use external data to automatically set their parameters. In doing so their generic parametric structure becomes not only a computational model but also a model for the physical system. The non-linear nature of adaptive systems such as neural networks gives the system designer the power of modeling very complex phenomena. It can be shown that neural networks are universal function approximators. In theory they can with an arbitrary accuracy approximate any function. Furthermore adaptive systems have strong generalization capabilities. Due to these appealing features it is easy to make the mistake of believing that they are complete black-box systems that can without any effort map any input-output relationship. In reality however the problem of defining a good model is moved from writing equations to making an efficient systems design and most importantly to choose and pre-process the right data. This can be accomplished by knowing how the different types of adaptive systems train and operate, or by using software that incorporates that knowledge. In this article we will look at the second approach and look at an integrated development environment, called Synapse, which is currently being developed by Peltarion. It fully encapsulates the whole development process, from the initial data mining to the final deployment of the designed system.

A Pragmatic Reasoning Schemas Approach to Improving the Teaching of Deductive Reasoning.

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Psychological studies of deductive reasoning have raised two interesting questions: (1) Do people use abstract, domain-independent inferential rules to think about everyday events? (2) Can reasoning be improved by formal instruction in the use of inferential rules? In respect to the curriculum taught in standard logic courses, most psychologists have answered these questions in the negative. The results of their studies raise serious questions about the teaching of logic, particularly the teaching of context-free, syntactic rules in undergraduate deductive logic courses. I will discuss what certain psychologists have to say about this and will consider some of their data and arguments. In addition, I will present some data from logic courses taught at my university and will discuss their bearing on these issues. Of particular import is where my classroom results seem to verify and depart from the results produced by psychologists. I conclude that psychologists are generally on the right track in terms of how best to train everyday deductive ability, and I'll indicate what that means for changing the deductive logic curriculum. Particularly, the pragmatic reasoning schemas approach will be explored, along with examples from my own classroom, it terms of its promise for replacing the context-free, syntactic rules approach in undergraduate deductive logic courses.

The Virtual University as an Educative Change Engine

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The opportunities that the technology offers to the universities to transform itself into axis of one more a more ethical social life, less unjust, more harmonious, depend nowadays, between many other things, about the capacity of the college students to organize new spaces of learning. To organize virtual spaces in which students and professors can extend and extend, beyond the classrooms, the experiences of significant learning, the reflections, the questioning and the relations with the whole society. The public reflection in Internet is now a way to open the doors of the classrooms, to do that the processes of construction of new knowledge and to engage in a dialog between the diverse disciplines of the human knowledge otter and is nourished of those who from the periphery of the on site campus, but in the same center of the virtual campus is now already present. The technology is an element that can serve to complement the daily efforts to construct spaces to engage in a dialog: without temporary and space fastenings the technology also is an average one to self construct us as more ethical beings, as beings who communicate and who are able to construct consensuses. Since there is this Edgar Morin: "the universal problem for all citizen: [is] how to obtain access to the information on the world and how to obtain the possibility of articulating them and of organizing them" the universities we must recognize like enormous task that, to know and to recognize the problems of the world, we needed a reform the thought. It entails to take advantage of and to spread new ways of use of the technology, new ways to guarantee the construction of a transdisciplinary vision of the world.

GENDER

Overcoming the Socio-Technical Divide: A Long-Term Source of Hope in Feminist Studies Of Computer Science

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In the age of ecofeminism it took some time until feminists listened to Donna Haraway's call to enjoy the blurring of boundaries between machines and organisms, between the natural and the artificial which she articulated in her famous 'Cyborg Manifesto'. Meanwhile shifts in traditional dichotomies are very welcome and they often give rise to the hope that they will evoke changes in the existing gender order and the relationship between gender and technology.
In the field of Computer Science feminist approaches often focussed on the socio-technical divide, since the discipline is one of the main arenas in which the boundary between the technical and the social is being formed, negotiated and constantly reconfigured. The socio-technical divide – and also its bridging - pervades disciplinary discourses, software development processes and manifests itself in the artefacts of information technologies that come into use. At the same time, this dualism has been deeply gender-coded in western societies.
In my contribution I want to revisit some controversies in the history of the discipline that do not only demonstrate the uncertainty and permeability of boundaries between technology and the social, but that have also been sources of hope for change from feminist perspectives. The central questions I want to discuss are: To what extent feminist hopes were fulfilled? And, if positive changes in the relationship between gender and technology are not observable, what happened instead? Did the discipline reject approaches that aimed at integrating social aspects into technology (design)? Or was the thesis wrong that a bridging of the socio-technical divide will go along with changes in gender relations? On the basis of this analysis I want to question the current hype promoting "interaction", "interactivity" or "interactionism" in various forms as a new motor of progress or hope – in mainstream Computer Science as well as in feminist criticism.

What Does it Mean to Know Computer Science? Perspectives from Gender Research

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The approaches to knowledge and epistemological basis for computer science (CS), on which research and education as well as development of applications are founded, are fundamental for its production of knowledge. In this article we call attention to and claim the need for research that focuses the epistemological basis for CS. By this, we are not primarily interested in this basis per se, but argue that the connection between the epistemology of CS and the practices of the discipline need to be elucidated. These connections are commonly overlooked, not to say neglected. Our position is that these bases are essential, not the least for educational practice. In this paper we raise the issue of how gender research developed within science and technology can be used within computer science, to approach and discuss foundations of the discipline, and what the implications of this reflection are for CS education. After an introduction, which serves to motivate the questions raised, we discuss issues concerning the foundations of computer science. We then introduce gender research, as we use it, and present some points where this type of research can contribute to the question "What does it mean to know CS?".