Abductive Reasoning: Logical Investigations into Discovery and Explanation
Atocha Aliseda

This talk will be a panoramic view of my recently published book at Springer. This book is a contribution to the study of abductive reasoning, providing logical foundations and a sample of several applications. Divided into three parts on the conceptual framework, the logical foundations, and the applications, this monograph takes the reader for a comprehensive tour through the taxonomy of abductive reasoning, via the logical workings of abductive inference ending with applications pertinent to scientific explanation, empirical progress, pragmatism and belief revision.

Multiagent-Based Simulation in Biology: A Critical Analysis
Francesco Amigoni and Viola Schiaffonati

Computer simulations have been playing a central role in biology in the very last years: they often participate in setting the theoretical knowledge that, in biology, is not always based on well-defined paradigms, like those of physics. The aim of this paper is to critically analyze pros and cons of a computer engineering approach to biological simulation: the multiagent paradigm. Multiagent systems are usually adopted for simulation when systems can be decomposed in individual cooperating entities. A positive issue of multiagent-based simulations is the possibility to perform in vivo experiments: they are computer-based simulations with the possibility to disturb the process by modifying the simulating system by adding and deleting elements. A negative issue of multiagent-based simulations is the weak validation of their results, which need to be rigorously confirmed for the approach to be really efficacious. At the moment, these results are compared just against other simulations and not against real data. This suggests that multiagent-based simulations are not yet mature to support the discovery of completely new results.

Model-Based Chemical Compound Formulation
Stefania Bandini, Alessandro Mosca, and Matteo Palmonari

Many connections have been established in recent years between Chemistry and Computer Science, and very accurate systems, based on mathematical and physical models, have been suggested for the analysis of chemical substances. However, such a systems suffer from the difficulties of processing large amount of data, and their computational cost grows largely with the chemical and physical complexity of the investigated chemical substances. This prevent such kind of systems from their practical use in many applicative domain, where complex chemical compound are involved.

In this paper we proposed a knowledge model, based on qualitative chemical knowledge, whose aim is to overcome such computational difficulties. The model is grounded on a representational framework that integrates ontological and causal knowledge about chemical compounds and compound transformations. The model allowed the design and the implementation of a system, that is based on the well known Heuristic Search paradigm, devoted to the automatically resolution of chemical compounding problems in the industrial domain of rubber compounds.

Constructing Cognitive Niches: The Role of Abduction
Emanuele Bardone and Lorenzo Magnani

In this paper, we argue that the continuous creation of cognitive niches is one of the main traits of human cognition. More precisely, we point out that a cognitive niche emerges from a network of continuous interplays between individuals and the environment, in which people alter and modify the environment by mimetically externalizing fleeting thoughts, private ideas, etc., into external supports.

In dealing with cognitive niche construction, we maintain that the notion of abduction can be relevant. That is, abduction may fruitfully describe all those activities in which we perform some smart manipulations to unearth more information or even create new external representations beyond the mere production of the mimetic ones. In this case, abduction can select or create new explanations that account for certain signs or clues, but can be also seen as a non-explanationist process strictly related to action (or to the “best” action).
Adaptive Logics: Broadening the Domain of Logic
Diderik Batens

Adaptive logics are not 'alternative logics' intended to replace classical logic (or any other standard of deduction). They are meant as means to characterize, in a strictly formal way, forms of reasoning that hitherto were not recognized as formal, notwithstanding their being formal and notwithstanding their frequent occurrence, both in scientific contexts and in everyday reasoning. In this sense, adaptive logics broaden the domain of formal logic; they locate in this domain a large set of reasoning forms that were often considered either as mistaken or as too indistinct to allow for a formal treatment.

A large number of adaptive logics has been studied by now. Most of them have a common formal structure, which is called the standard format. The syntax and semantics of adaptive logics in standard format derive directly from this structure. While adaptive logics have several unusual properties, it is possible to prove the presence of these properties in a way that complies with the usual meta-theoretic requirements. Actually, most of the meta-theoretic properties (including soundness and strong completeness) have been proved in terms of the standard format (without referring to specific properties of a particular logic). With these difficulties out of the way, formulating a new adaptive logic (for a given reasoning form of the right structure) is a manageable task.

Several existing logical systems, for example certain non-monotonic logics, have been characterized in terms of adaptive logics. In this way, adaptive logics have a systematizing and unifying effect.

Several useful adaptive logics will be presented and illustrated, some relating to scientific contexts, others relating to more pedestrian contexts. The effects of the standard format will be clearly explained. It will be shown that adaptive logics may easily be combined into stronger systems where this is appropriate. Special attention will be paid to the way in which the dynamic proofs of adaptive logics explicate the reasoning processes to which they pertain.

Mapping Perspectives on Abduction, and Complementing Visualization and Simulation with Topology-Based General Situation Gauging
Marika Bouchon

Throughout the history of medicine, healing, and clinical practice, picturing the body and its ailments has been an intrinsic part of the art. Yet a blind spot is still not explained: the undiagnosable ‘discomfort’, a low-grade sense of ‘unhealthy’ that affects holistically bodymind and one’s life, and eventually grows into ‘illness’ and acute or chronic disease. In order to carry out a trans-disciplinary study of ‘health ecology’ and its socio-cultural aspects, two imaging methods were developed.

The first is a general ‘perspectival mapping’ based on linguistic patterns in scientific and human domains. Using three axes of complexification (or development), and two fundamental parameter-types (eg symmetry-harmonics, pattern–motion, dialogic-trope), it maps epistemological biases, processes of explanation reformulation and cognitive reframing of experience, with correlate semantic drifts and logical shifts. How this works is shown with the notion of abduction.

The second translates the above mapping into a geometric modeling to draw kinetic-directional descriptions of ‘activation’ and ‘topographic projection’ limited to 3 orders (eg from core to surfaces, through tubes – such notions are found in early forms of Chinese medicine and ancient texts). This animated imaging could offer applications for puzzling aspects of health: deposits (eg atherosclerosis, arthritis, cysts, obesity, etc.), transports (eg insulin/glucagon, blood susceptibility to mosquito borne viruses or malaria), spreading’ (eg acne, internal development of illness).

Animations taken from mathematical topology show how such 3Dspatial-stereo animated geometry is inherent to sensing the (body-brain/self)-world. It can be tracked back to archaic word-roots and early graphic symbolism (eg simple Chinese characters’ parts), yet its practical in daily life parlance is discounted by current culture and doctors alike as ‘primitive’.

In its complete bi-directional form, ‘nexial-topologic situation modelling’ can help ‘gauge the shaping’ of boundary conditions, and deal with ‘not self’, and approach integrity/straightness without requirement for compensatory stabilisation or establishment.

Information, Self-Organization and Robots
Mariana Claudia Broens and Maria Eunice Quilici Gonzalez

We investigate, from a philosophical perspective, the relation between meaningful information, self-organization and action in the context of evolutionary robotics. Emphasis is given to Aristotle’s ideas on the role played by the sense of touch in action. From this perspective, meaningful information is provisionally characterized as a self-organizing process of pattern generation that constrains action grounded primarily on touch. This process
is considered a part of the establishment of order parameters in the flow of events relating organisms and environment in order to help with their survival. We argue that artificial models like robots, which deal only with reactive forms of contact, rather than with touch, do not operate with meaningful information.

The Application of Artificial Intelligence to Commercial Problems
David Brown

The Institute of Industrial Research (IIR) has been established at the University of Portsmouth to enable Industry and business to become more globally competitive through the application of Artificial Intelligence (AI) techniques.

The institute has been involved in many industrial applications. These include diagnostics and failure prediction for process machines, embedded Intelligence for underwater vehicles, image enhancement and clarification and brain wave analysis.

A series of projects will be described which demonstrate how computational systems can adapt and learn by interacting with their environments.

Polynomizing: Using Polynomial Forms as Reasoning Models
Walter Carnielli

Polynomizing is a term that intends to describe the uses of polynomial-like representations as reasoning strategy and tool for scientific discovery. I show how proof-theory and semantics of (classical and non-classical) logics can be approached from this perspective, and discuss the assessment of this prospect.

Human Motion Analysis using Normalized Qualitative Templates
Chee Seng Chan, Honghai Liu, and David J. Brown

This paper proposes an approach to classify human motion using qualitative normalised templates. The proposed method consists of construction of human arm and leg models, qualitative representation of prior knowledge of human arm and leg motions and a search algorithm. First, conventional robotic methods is employed to build up a generic vision model for a human arm and leg; Secondly, qualitative robotic model proposed by Liu and Coghill is adopted to construct qualitative normalised templates; Finally a search algorithm is provided to match the vision model with the templates in video sequences. Experimental evaluation demonstrates the ability of proposed method in classification of simple human motions (e.g. running and walking).

Peircean Pragmatic Truth and da Costa’s Quasi-Truth
Itala M. Loffredo D’Ottaviano and Carlos Hifume

As it is well known, for Charles Peirce a sign is anything related to a second thing, its object, such that a third thing is brought to relate with the same object, its interpretant. Such an interpretant is also a sign, that will bring a fourth thing, another interpretant for the same object, and so indefinitely. As this process continues in the future, the current interpretations are partial interpretants. Peirce considers that every thought only occurs through signs and knowledge is obtained as an inferencial investigation process, from a doubt and looking for a stable belief. For Peirce, the method of science is the most adequate method to reach stable beliefs. In the scientific method, beliefs are determined by reality. Therefore, the truth is the final opinion or the public acceptance of the result obtained in a given investigation; and a sign, or a truth-bearer, is true if it corresponds to reality, according to the conditions of the experience. As such signs are interpretants, the current truth is a partial truth.

Newton da Costa and collaborators introduced a formal definition for the concept of pragmatic truth, named quasi-truth, trying to capture the meaning of the theories of truth of the pragmatist thinkers such as Peirce and James. By defining the mathematical structure of partial structure and by using the semantical approach of theoreic or model theory, da Costa considers his conception of quasi-truth the truth conception inherent to the empirical theories.

Hifume’s Master Dissertation analyses the modal logical system QT-SSQ*, introduced by da Costa, that can be used as the underlying logic for theories whose truth conception is the quasi-truth. In this work, we present a Kripke model semantics for this logic and among some fundamental results, we show that the logic QT-SSQ* is a kind of Jaskowski discussive logic, being a paraconsistent modal logic.
Qualitative Spatial Reasoning with Conceptual Neighbourhoods for Agent Control
Frank Dylla and Jan-Oliver Wallgrün

Research on qualitative spatial reasoning has produced a variety of calculi for reasoning about orientation or direction relations between point objects or line segments. Such qualitative abstractions are very helpful for agent control and communication between agents or agents and humans. Despite the variety of calculi it is reasonable for many tasks to derive calculi especially for fulfilling certain needs. The development of a new calculus is a time consuming and error prone process as most of work has to be done by hand. In such a context it is helpful to build up new calculi on the basis of already existing ones with well-investigated properties. We represent diverse existing calculi on the basis of the Oriented Point Relation Algebra and show how to derive their conceptual neighbourhoods. We will give examples how such neighbourhoods can be exploited for agent control and communication.

An Extended Semantics for Model-Based Spatial Reasoning
FEI Dingzhou

Qualitative Spatial Reasoning concerns not only the common-sense knowledge of the physical world, but also complex phenomenon from scientific areas by building qualitative models, intentionally being not respecting unavailable quantitative models. The main task for qualitative reasoning is to represent spatial properties of the world by using formal logics.

This paper will consider cognitive aspects of qualitative spatial reasoning. This is, model-based reasoning. Johnson-Laird developed a theory for model-based reasoning, called as mental model theory. According to this theory, mental models can be applied metaphorically in problem solving when they involves the truth of statements by computation and reasoning in the semantic domain, while the rule-based reasoning is thought to be erratic description of human reasoning by means of manipulation of formal rules of deduction. The mental model is a relational model, which is a static frame consisting of tokens and a set of relations among the entities. The Qualitative Spatial Reasoning of my paper will focus on this type of relational model - the spatial model in which the relations of interest are spatial in nature: tokens are located within a symbolic, multi-dimensional space.

My paper will extend the model provided by J. Glasgow and A. Malton, based on the array representation created by them for capturing model-based spatial reasoning. An array representation is arranged so that there is a mapping from the structure of the symbolic array to the structure of the space involved. The main improvement is that we consider not only direction of the array representation like two authors, but also distance between two regions being connected (if one want to think of regions as sets of points). But my paper defines the distance in different way with B. Clarke’s primitive notion $C(x,y)$ in the RCC system, and gives the concept of relative distance between two regions. Furthermore, we will show that the concept of relative distance can be suitable for the array representation.

Motion Control of Rigid Robot Manipulators via First and Second Order Sliding Modes
Antonella Ferrara and Lorenza Magnani

A motion control strategy for rigid robot manipulators based on sliding mode control techniques and the compensated inverse dynamics method is presented in this paper. The motivation for using sliding mode mainly relies on its appreciable features, such as simplicity and robustness versus matched uncertainties and disturbances. Furthermore the proposed approach avoids the estimation of the time-varying inertia matrix. As a preliminary step a first order sliding mode control law is presented. Then a second order strategy is discussed. In both cases the problem of chattering, typical of sliding mode control, is suitably circumvented. Simulations results demonstrates the good tracking properties of the proposed control strategy.

Expanding Abduction
Torgeir Knag Fylkesnes

Most research on abduction is preoccupied with scientific discovery. Within this context, abduction is often defined as “the formation of explanatory hypothesis” (Magnani 2001). Consequently, the “surprising fact” is seen as a result of anomaly, inconsistency or non-standard events that a specific explanatory system does not answer.
I argue that the theoretical account of abduction stemming from the research of scientific creativity has been overemphasised, and as such jeopardized the general application of abduction as “covering all operations by which theories and conceptions are engendered” (CP. 5.590–604). Also, the explanatory account of abduction has a tendency to define the “surprising fact” in a way that exclusively explains certain kinds of abduction. This account works contra productively if the aim is a general account of abduction.

Originally, the logic of abduction was created to answer the famous Kantian problem, and what Peirce called “the knock on the door for philosophy”: how are synthetical judgments possible? The logic of abduction, “covering all operations in which theories and conceptions are engendered”, was the answer to this general question. But if this account is seen at the same epistemological level as the explanatory account of abduction (“the formation of explanatory hypothesis”), they contradict each other.

This contradiction may be solved by viewing the explanatory account of abduction as a “kind of” abduction, as subset of the general definition. Accordingly, we also have to define surprises more broadly, as cues, or instances of resistance – maybe viewed as an obstacle of some kind, that “cues” doubt: “Doubt, usually, perhaps always, takes its rise from surprise”.

I hold these as imperative adjustments if we accept abduction as a general concept and an answer to “how synthetical judgements are possible?” Making these adjustments enable us to “move on”, expand the use of abduction as descriptive tool of creative processes on other areas of conduct, such as football, politics, theatre-plays, e.g. other areas “in which theories and conceptions are engendered”.

**CYBERNARD:**

**Computational Reconstruction of Claude Bernard’s Scientific Discoveries**

Jean-Gabriel Ganascia, David Elkaïm, and Claude Debru

With epistemological insight and artificial intelligence techniques, our aim is to reconstruct Claude Bernard’s empirical investigations with a computational model. We suppose that Claude Bernard had in mind what we call a “kernel model” that contains the basic physiological concepts upon which Claude Bernard builds his general physiological theory. The “kernel model” provides a simplified view of physiology, where the internal environment – the “milieu intérieur” –, mainly the blood, plays an essential role. According to this perspective, we assume that the “kernel model” allows Claude Bernard to make some hypotheses and to draw out their logical consequences. More precisely, the role of the “kernel model” is twofold: on the one hand, it helps to generate and manage working hypotheses, for instance to enumerate the probable effects of a toxic substance, on the other hand, it derives, by simulation, the most plausible consequences of each of those hypotheses.

We shall show how this “kernel model” can be specified using both description logics and multi-agent systems. Then, the paper will explain how it is possible to build, on this “kernel model”, a virtual experiment laboratory which lets us construct and conduct virtual experiments that play a role similar to the role of thought experiments. More generally, the paper constitutes an attempt to correlate Claude Bernard’s experiments, achieved to corroborate or refute some of his working hypotheses, to virtual experiments emulated on the “kernel model”.

**Creativity, Abduction and the Synthetic Methodology**

Maria Eunice Quilici Gonzalez, Willem Ferdinand Gerardus Haselager, Mariana Claudia Broens, and Fabricio Loffredo D’Ottaviano

One of the main contributions of Cognitive Science to the contemporary philosophical and scientific project of explaining the nature of intelligence is its *synthetic methodology* that involves the development of mechanical models of mental activities. In the present paper we investigate the advantages and disadvantages of this methodology concerning the understanding of the nature of creativity. Special emphasis is going to be given to the following question: Is it appropriate to investigate creative processes from a mechanistic perspective or do they involve subjective elements which cannot - in principle - be investigated from such a perspective? This question will guide the present research of creativity focusing on the nature of abductive reasoning. As an initial hypothesis we characterize creativity as a self-organizing process in which abductive reasoning occurs allowing the expansion of stable habits or beliefs. We argue that an understanding of how self-organizing processes involving abductive reasoning may take place in creative systems could help with the debate on the adequacy and limits of the synthetic methodology in studies of intelligence.
Cognition, Modeling and the Collapse of Civilizations
Michael E. Gorman

Jared Diamond, in his provocative book *Collapse*, describes multiple cases where civilizations went through periods of collapse, e.g., the Mayans, the Anasazi and the natives of Easter Island (Diamond, 2005). These collapses were caused by changes in the local system brought about by a combination of natural and human activity. So, for example, the Mayan and Anasazi civilizations developed agricultural technologies during periods when the climate was favorable. The result was an expanded population which could not be supported when extended droughts occurred. But collapse was not inevitable; all of these cultures made choice; indeed, some like the Anasazi survived by changing practices.

Our global civilizations have now created the anthropocene, in which human, natural and technological systems are inextricably intertwined. Human activity can, in a very short time, create holes in the ozone layer and change the climate across the entire planet (Flannery, 2005).

According to Brad Allenby, our species has a responsibility to manage the global ecosystem (Allenby, 2005). Indeed, it the key to the survival of civilization. This presentation will explore the cognitive capabilities needed to undertake this task, incorporating the latest results from a workshop on trading zones and interactional expertise, to be held at Arizona State University from May 21 to 25. Modeling will be one of the tools discussed in the talk, including results on the economic and health impacts of air pollution in China (Ho & Nielsen, 2006).

Fuzzy Policy Reinforcement Learning in Multi-Robot Systems
Dongbing Gu and Erfu Yang

A multi-agent reinforcement-learning algorithm with fuzzy policy is addressed in this paper for dealing with the learning and control issues in cooperative multi-robot systems. The parameters of fuzzy policy are finely tuned by the policy gradient multi-agent reinforcement learning algorithm to improve the overall performance of an initial controller (policy). This learning algorithm is used in a leader-follower robotic system where two robots adopt different controllers and a flocking system where multiple robots adopt the same controller. Our simulation results demonstrate that the control performance can be improved after the learning.

The Wondering Angels of the Fractal Art:
A Non-standard Introduction to an Fractal Art Aesthetics
Viorel Guliciuc

Fractal Art is that subclass of the digital arts we describe as the art form using the computer as the main instrument in the creative process.

Improving Robustness of Mobile Robots using Model-Based Reasoning
Michael Hofbaur, Johannes Kob, Gerald Steinbauer, and Franz Wotawa

Retaining functionality of a mobile robot in the presence of faults is of particular interest in autonomous robotics. From our experiences in robotics we know that hardware is one of the weak points in mobile robots. In this paper we present the foundations of a system that automatically monitors the driving device of a mobile robot. In case of a detected fault, e.g., a broken motor, the system automatically reconfigures the robot in order to still allow to reach a certain position. The described system is based on a generalized model of the motion hardware. High-level control like path-planner only only to change its behavior in case of a serious damage. The high-level control system remains the same. In the paper we present the model and the foundations of the diagnosis and reconfiguration system.

Do Computational Models of Reading Need a Bit of Semantics?
Remo Job and Claudio Mulatti

Coltheart, Rastle, Perry, Langdon, & Ziegler (2001) claim that “the psychology of reading has been revolutionized by the development of computational models of visual word recognition and reading aloud”. They attribute this to the fact that a computational model is a computer program – an algorithm – “that is capable of performing the cognitive task of interest and does so by using exactly the same information-processing procedures as are specified
in a theory of how people carry out this cognitive activity” (Coltheart et al., 2001; page 204). According to this view, the computational model is the theory, not a simple instantiation of a theory.

In this paper we argue that computational models of reading have indeed helped in dealing with such a complex system, in interpreting the phenomena underlying it, and in making sense of the experimental data. However, we also argue that it is crucial for a model of reading to implement a computational semantic system that is as yet a missing component of all computational models. We provide two reasons for such a move. First, this would allow explaining some phenomena arising from the interaction of semantics and lexical variables. In this section, we will review the following empirical findings: faster response times to polysemic words (e.g. Hino & Lupker, 1996) and slower response times to synonyms (Pecher, 2001); the leotard (Rodd, 2004) and turpule effects (Forster and Hector, 200); the asymmetry of the neighbourhood density effect in free and conditional reading (Mulatti & Job, 2006); and semantic priming (McNamara, 2005). Second, such an “enriched” model would be able to account for a richer set of tasks than current computational models do. Specifically, it would simulate tasks that require access to semantic representation to be performed, such as semantic categorization and semantically-based conditional naming.

We will present a computational instantiation of a semantic module that accounts for all the described phenomena, and that has helped in generating predictions that guides on-going experimental activity.

An Examination of Model Based Reasoning in Science and Medicine in India
Sundari Krishnamurthy

Ancient Indian knowledge systems can be traced through the Vedas, Epics, Philosophical systems or Darsanas, mathematical and scientific systems.

The Vedas are the oldest existing literature in the world. They are four in number and are called the: The Rg-Veda, Sama -Veda, Yajur-Veda and Atharva-Veda. Each Veda is divided into Mantras, Brahmans, Aranyakas and Upanisads. The Vedas explore reality and attempt to understand it through examining nature, humanity and the Ultimate Reality. It is both an inner journey, when the self is explored, and an outer journey, where the cosmos is attempted to be mapped.

The epics of Ramayana and Mahabharata (in which is found the Bhagavad-Gita), through myth, fable, legend and heroic ballads, try to convey wisdom, even to the ordinary understanding of ordinary people.

The self conscious philosopher formulated the ‘darsanas’ or views of reality and we have six of them. The Nyaya School founded by Gautama, was primarily a school of Logic. Kanada, who founded the Vaisesika school defined categories, and examined matter at great length, and even postulated the existence of atoms which they termed as ‘anu’. The Sankhya school of Kapila enunciated the evolution of the world, from both matter (prakriti) and mind/soul (Purusa). The dynamic interaction between the two leading to the complex evolution of the universe.

Patanjali’s school of Yoga, examined the mind of man in detail, and came out with a philosophy of yoking the body and the mind, through physical exercises called ‘asana’, and a path of many layered meditation (dhyana) which ultimately led to liberation (samadhi). The Purva and Uttara Mimamsa schools of philosophy took a curve and went back to the Vedic period to re-examine the axioms of that period and formulated new systems of their own. This led in the modern period to the formulations of distinct schools of philosophy: absolute monism of Sankara, qualified dualism of Ramanujacarya and dualism by Madhvacarya. Examining these six systems gives an insight into the model based reasoning of philosophy in ancient India.

Buddhism and Jainism not only evolved as religions, but also examined the tenets of the six schools of philosophy and stated their own epistemological, metaphysical and ethical standpoints, which upon analysis yield the axioms and theorems of the Buddhist and Jain thinkers.

Mathematics was an important subject that was found in ancient India, and was widely used in formulating calendars, propounding astrological theories and made intricate calculations for astronomy. Mathematics and its sub-systems like algebra and geometry provided the basis for Indian architecture, art, sculpture and painting. Vastu sastra was a science of space, which aided designers in designing homes, towns and temples. Physics, chemistry, biology and astronomy were other sciences which showed advanced development in ancient India.

An examination of the knowledge systems in ancient India thus reveal modeling that was used by their founders and proponents.

Re-Discovery of the Nature and Logic of Scientific Discovery
LEI Liang

Analyzing scientific discovery semantically, or researching the activities of scientific discovery themselves historically, we will find that, despite the social, historical, and psychological properties, scientific discovery is actually a logical process of generating, choosing, revising receiving and interpreting new hypothesis, the logical mechanism is just abduction advocated by Charles S. Peirce and Norwood R. Hansen etc. Moreover, it is the new achievement of modern cognitive science that makes it clear that background theories and knowledge play an
important role in the course of hypothesis generation and selection, and promotes innovation of the forms of abduction, thus, the questions why and how abduction can become the logical mechanism of scientific discovery is answered satisfactorily.

**A Model-Based Approach to Scientific Explanation**  
LI Ping and LI Dachao

This paper argues for the claim that explanation is a kind of model-based reasoning and a semantic process of model-based understanding, and characterizes a psychological-computational model of scientific explanation. We will address some questions concerning the underlying cognitive processes or mechanisms of explanation; in particular, emphasizing the significances of Thagard’s account of multi-modal representations and Magnani’s work on external representations in the model of explanation, we will provide a detailed analysis of the representational problem of complex tasks of scientific explanation in terms of the account of multi-form-and-multi-model integration of mental representations.

**Scientific Aesthetizing and Scientific Cognition**  
LI Xing-min

Scientific aesthetizing and scientific cognition are closely related which manifests itself in the following three aspects:

First, scientific aesthetizing offers great motivation for the scientists to make scientific inquiries. At the beginning of modern science, Copenicus, Kepler, Galilei and Newton among others took aesthetizing of nature and science as the encouragement to their research and this excellent tradition lasts till today. Poincare, the great master of scientific aesthetics, thought, as nature is beautiful, it is worth studying and as science is beautiful it is worth developing. Pierson said: “The continuous pleasure which aesthetic judgment brings is one of the main pleasures of pure scientific quest.” Einstein points out: “The longing for the predetermined (predestined) harmony is the source for the inexhaustible will and patience.” As a matter of fact, scientists often feel the pleasure of beauty when engaging in scientific creation. The delight brought by the sense of beauty may also enhance one’s will to produce and promote the quest for truth. Scientific aesthetic elements play an important part in creating the atmosphere for producing.

Second, scientific aesthetizing is fairly important in scientific invention or scientific discovery. The main object of scientific theory is to express harmony discovered in nature, which leads the scientist to accept as science things conforming to aesthetic judgment. It turns out that in so doing the scientist is often right, and at the moment of the springing up of new scientific concepts and principles, unconscious aesthetic appreciation and judgment are even decisive. Just like the birth of great artistic works, scientific invention is filled with aesthetic elements because invention is the choosing of useful combination by aesthetizing and intuition. In a word scientific aesthetizing is the breakthrough in scientific invention or scientific discovery. And further, epoch-making scientific invention may quite well lead to revolution in science, therefore scientific aesthetizing and scientific revolution are often inextricably intertwined with each other.

Third, scientific aesthetizing is not only the breakthrough in scientific invention or scientific discovery, but also the touchstone of the evaluation or the defense of scientific theories. As a matter of fact, the two processes are often interwoven with and hard to distinguish clearly from each other. For example, the aesthetic evaluation of old theories and the aesthetic appreciation of new ones also take part in the whole process of scientific invention. Many famous scientists think intuition and aesthetic judgment are decisive elements deciding whether to accept or refuse certain theoretical models. The obvious reason for using aesthetic evaluation is that scientists must make choices among many/several theories equally satisfying empirical standards – to choose the theory which is beautiful. What’s more important is that among the theories equally conforming to experience, the one which is beautiful is that which is ontologically nearer to the reality, hence the more basic theory while the theory which is not beautiful is imperfect, transient and transitional and will be replaced by better theory sooner or later.

**WuXing Intertwined Model and Disease Expalantion: A Discussion of the Foundamental Cognitive Model in Traditional Chinese Medicine**  
LIANG Tong

Yin-yang and WuXing theory which has embedded in the long-lasting Chinese heritage, is regarded as the fundamental and pivotal element to understand the traditional Chinese medicine (TCM) theory. In addition, Wu Xing theory (also treated as a theory about five basic phases including Metal, Wood, Water, Fire and Earth) in
particular, is thought to strengthen and systematize the holistic character of TCM, which occasionally meets with the sympathy response from such as proponents of holism in turn.

Since the TCM has a close correlation with the ancient Chinese tradition especially Chinese philosophy, it appears to be unwise of merely focusing on the unfolding history of TCM without deliberately considering the relevant background containing ancient Chinese philosophy.

Nevertheless, the thinking pattern with which ancient Chinese scholars or philosophers got used to would incline to focus on the process rather than the object in the world, which could generally make for the oriental specific insight with a widened and synthesized angle in contrast to the western analytical and individualised viewpoint. WuXing would rather be treated as five pivotal phases (or process) than merely five basic elements, which seemingly means a dynamic and vital analogy between the complex system of Nature and five phases corresponding to relevant characters. With an association of ideas according to WuXing epistemological pattern, Chinese thinkers and philosophers are capable to handle with such as the united concourse of life, society and nation intelligibly.

Though the WuXing theory and others have not lead TCM to a reasonable transition from traditional to modern forms and disciplines as many western scholars think, TCM or namely Chinese contemporary medicine, has at least retain fruitful cognitive resource on the contrary. In my opinion, WuXing intertwined model should be carefully reconsidered and seriously revaluated with reference to the latest cognitive turn occurred in the contemporary philosophy of science.

Owing to the specific attributes of Wu Xing intertwined model which may help to illustrate its beneficial promotion to cognitive significance, I would focus on three points in my paper, that is the particular concept categorization different with western scientific medicine, non-linear methods and techniques analogously applied to complex systems and the practical significance of efficacy evaluation of acupuncture released by the U.S. National Institutes of Health.

**Towards Model-Based Robot Intelligent Connection**

Honghai Liu

Intelligent connection plays a crucial role in constructing an intelligent robotic system. This talk proposes a model-based approach towards connecting low-level sensing, control tasks and high-level symbolic cognitive reasoning tasks in a robot system. First, we revisit fuzzy qualitative trigonometry which is the representation of conventional trigonometry in terms of fuzzy qualitative reasoning techniques. Then, we propose an extension of fuzzy qualitative derivatives to fuzzy qualitative trigonometry, which leads to a general description of robot kinematics. Fuzzy qualitative transformation, position and velocity of a robot are derived and discussed. Finally, we introduce a vector-based quantity space and highlight the impact of the proposed methods to the connection problem. The proposed methods have been implemented into XTRIG MATLAB toolbox, using which examples are given throughout the talk.

**Interaction Metaphor and Embodied Cognition**

LIU Xiaoli

To eliminate the deficiencies of the computational metaphor, the situated cognition, embodied cognition and the dynamic theory of cognition have revised the traditional concepts of cognition in recent years. The new approach to cognitive science based on the interaction metaphor and embodied philosophy reveals the complexities of cognitive processes, and provides the new concept about the nature of cognition and the new enlightenment on reconsidering the problems, such as those of mind-body and mind-brain-machine.

**Iconlike Thinking In Model-based Reasoning**

LIU Zubin

Iconlike thinking is a methodology to concrete, by visual icons, the reasoning mechanism such as role transition, discovering new factors, induction or analog etc. Iconlike thinking comes from the Book of Changes, one of the greatest books of ancient China. The meta-models about is exemplified by interesting stories and the reasoning mechanism explained by iconlike thinking. The relations between the iconlike thinking and ontology, common sense and graph grammar are explored.
An Algebraic Approach to Model-Based Diagnosis
LUAN Shangmin, Lorenzo Magnani, and DAI Guozhong

Traditional approaches to computing minimal conflicts and diagnoses use search technique. It is well known that search technique may cause combination explosion. Algebraic ways are good choice to solve the problem. We give an algebraic approach to model-based diagnosis. A system with an observation can be represented by a petri net, consistency check of a system with an observation corresponds to checking whether there exist at least two places \( p_1 \) and \( p_2 \) labelled with a literal and its negation in its corresponding petri net and a reachable marking \( M \) from \( M_0 \) such that \( M(p_1) \) and \( M(p_2) \) are not zero. The reachability can be represented by a algebraic equation \( M = M_0 + CX \), i.e., \( M \) is reachable from \( M_0 \) if there is a \([0,1]\)-vector \( X \) such that \( X \) is a solution of the algebraic equation. Hence, for a system with an observation and its corresponding petri net \( PN \), checking whether there are conflicts between its function and behavior is equivalent to checking whether there are a \([0,1]\)-vector \( X \) and at least two places \( p_1 \) and \( p_2 \) labelled with a literal and its negation in \( PN \) such that \( M(p_1) \) and \( M(p_2) \) are not zero, where \( M = M_0 + CX \).

In this paper, we first give a way to transform a system with an observation into a petri net, and show that a contradiction occurs in a system with an observation if and only if there are at least two places \( p_1 \) and \( p_2 \) labelled with a literal and its negation in its corresponding petri net \( <P,T,W,M_0> \) such that \( M(p_1) \) and \( M(p_2) \) are not zero, where \( M = M_0 + CX \), \( X \) is the maximal \([0,1]\)-vector. A \([0,1]\)-vector \( X \) is called maximal if, \(|M| = |M_0 + CX| \) is maximal and for a transition \( t \in T \), if \( M(t) \) is 1, then \( t \) is enable. Then we introduce an algorithm to compute the maximal \([0,1]\)-vector \( X \) for a petri net. Furthermore, algorithms for computing minimal conflicts and diagnoses are introduced. We also compare our work with related works.

Multimodal Abduction:
Externalism and Internalism in Model-Based Distributed Creativity
Lorenzo Magnani

Our brains make up a series of signs and are engaged in making or manifesting or reacting to a series of signs: through this semiotic activity they are at the same time engaged in “being minds” and so in thinking intelligently. An important effect of this semiotic activity of brains is a continuous process of “externalization of the mind” that exhibits a new cognitive perspective on the mechanisms underlying the semiotic emergence of creative abductive processes of meaning formation. Hence, we can think of minds as material, “extended”, and artificial in themselves. A considerable part of human abductive thinking is occurring through an activity consisting in a kind of reification in the external environment (that originates what I call “semiotic anchors”) and a subsequent re-projection and reinterpretation through new configurations of neural networks and chemical processes. I also plan to illustrate how this activity takes advantage of hybrid representations and how it can nicely account for various processes of creative and selective abduction, bringing up the question of how “multimodal” aspects involving a full range of sensory modalities are important in model-based creative hypothetical reasoning.

Adaptive Logics for Different Types of Abductive Reasoning
Joke Meheus

The aim of this paper is twofold: (i) to distinguish between different types of abductive reasoning and (ii) to show that each of these types can adequately be captured in terms of so-called adaptive logics.

Adaptive logics for abduction have several nice properties. First, they nicely integrate deductive and abductive steps, and moreover have a decent proof theory. This proof theory is dynamic, but warrants that the conclusions derived at a given stage are justified in view of the insight in the premises at that stage. Next, they have a nice semantics that is sound and complete with respect to the dynamic proof theory. Finally, they are much closer to natural reasoning than other available systems (for instance, logic-based approaches for abduction in Artificial Intelligence).

After briefly discussing the basic ideas behind adaptive logics for abduction, an overview will be given of the different application contexts for abductive reasoning. It will be shown, for instance, that in some application contexts one searches for a unique abductive explanation for each explanandum (the logically weakest one), whereas in others one looks for alternative explanations for the same explanandum. For each of the application contexts, a suitable adaptive logic will be presented (both the semantics and the proof theory).
Construction of Robot Intra-Modality and Inter-Modality Coordination Skills by Developmental Learning
Qinggang Meng and Mark Lee

From infants to adults, each individual undergoes changes both physically and mentally through interaction with environments. This cognitive development is usually staged, exhibited as behaviours changes and supported by neuron growth and shrinking in the brain. The ultimate goal for an intelligent artificial system is to automatically build its skills in a similar way as the mental development in humans and animals, and adapt to different environment. In this paper, we present an approach to constructing robot coordination skills by developmental learning inspired by developmental psychology and neuroscience. In particular, we investigated the learning of two types of robot coordination skills: intra-modality mapping such as sensor-motor coordination of arm; and inter-modality mapping such as eye/hand coordination. A self-organising radial basis function (RBF) network is used as the substrate to support the learning process. The RBF network grows or shrinks according to the novelty of the data obtained each time during the robot interaction with environment, and its parameters are adjusted by a simplified extended kalman filter algorithm. The paper further reveals the possible biological evidences to support both the system architecture, the learning algorithm, and the adaptation of the system to its bodily changes such as due to tool-use. In order to investigate embedded developmental learning algorithms we have built a laboratory robot system with two industrial quality manipulator arms and a motorised pan/tilt head carrying a colour CCD camera. The experimental results demonstrated that the system can develop its intra-modality and inter-modality coordination skills by constructing mapping networks in a similar way as humans and animals during their early cognition development. In order to adapt to different tool sizes, the system can quickly reuse and adjust its learned knowledge in terms of the number of neurons, the size of receptive field of each neuron and the contribution from each neuron in the network.

Abduction, Medical Semeiotics and Semioethics: Individual and Social Syptomatology from a Semiotic Perspective
Susan Petrilli

In this paper global semiotics is developed in the direction of what we propose to call semioethics. As a unique semeiotic animal, that is to say, the only animal capable of reflection upon signs and communication, the human being has a singular responsibility toward life (which of signs and communication is made), which also means the quality of life. More than limited responsibility, the type of responsibility involved is unlimited responsibility in the terms so far discussed, responsibility without alibi, absolute responsibility.

The capacity for abduction as the condition for critical and dialogic totalization implies that the ability to grasp the reason of things cannot be separated from the capacity for reasonableness. The issue at stake may be stated in the following terms: given the risks inherent in social reproduction today for semiosis and for life, human beings must at their very early transform from rational animals into reasonable animals.

It is significant that Peirce too should have turned his attention specifically to the normative sciences in the final phase of his research. He linked logic to ethics and to esthetics: while logic is the normative science concerned with self-controlled thought, ethics is the normative science that focuses on self-controlled conduct, and esthetics the normative science devoted to ascertaining the end most worthy of our espousal. In this context, Peirce took up the question of the ultimate good, summum bonum, or ultimate value which he refused to identify with either individual pleasure (hedonism) or with a societal good such as the greatest happiness for the greatest number of human beings (English utilitarianism). Rather, he insisted that the summum bonum could only be defined in relation to the ‘evolutionary process’, that is, to a semiosic process of growth. Specifically, he identified the highest good in the continuous ‘growth of concrete reasonableness’.

Our responsibilities toward life in the global communication-production phase of development in late capitalist society are enormous, indeed unbounded, also in the sense that when we speak of life the implication is not only human life, but all of life throughout the whole planetary ecosystem, from which of course human life cannot be separated. As the study of signs semiotics cannot evade this issue.

Originally, semiotics was understood as ‘semeiotics’ (a branch of the medical sciences) and was focused on symptoms. Nowadays the ancient vocation of semiotics as it was originally practiced for the ‘care of life’ must be recovered and reorganized in what we propose to call ‘semoietic ’ terms. This issue is particularly urgent in the present age in the face of growing interference in communication between the historical-social sphere and the biological sphere, between the cultural sphere and the natural sphere, between the semiosphere and the biosphere.

Semioethics is the result of two thrusts: one is biosemiotics, the other bioethics.

From this point of view semiotics is listening, it is turned to listening, this time not in the sense of the general theory of signs subtending semiotics, but in a medical sense, semiotics must be listening in the sense of medical semiotics or symptomatology, semiotics must listen to the symtoms of today’s globalized world and identify the
different expressions of unease and disease – in social relations, in international relations, in the life of single
individuals, in the environment, in life generally over the entire planet.

The aim is to make a diagnosis, a prognosis and to indicate possible cures to the end of making a future for
globalization, for the health of semiosis in opposition to a globalized world tending towards its own destruction.

Abductive Inference and Conditional Iteration
Claudio Pizzi

Abductive inference, in the sense of inference to the best explanation, has many features in common with
counterfactual inference: in fact, they are both rational forms of inference consisting in the choice of the most
informative conclusion inside a qualified set of possible incompatible conclusions. This does not mean that there is
an equivalence between counterfactual conditionals of form $\neg A > \neg B$ and abductive conditionals of form $B > A$: on
the contrary, such object-language formulas turn out to be non-equivalent both in Stalnaker-Lewis conditional
logics and in consequentialist conditional logics. However, among the important common properties they share is
that they may appear embedded in higher order conditionals, i.e. as antecedents or as consequences of other
conditionals.

Evidence is given that conditional iteration - normally neglected in the literatureoffers the ground for a
solution of some well-known epistemological difficulties, such as for instance the problem of redundant causation
in the counterfactual theory of causality. It is also remarked that abductive conditionals embedded in higher order
conditionals - so the idea of hypothesizing possible abductions- has a non-trivial role in various kind of reasoning.
In this connection, special attention is given to the problem of causal pre-emption, i.e. to the special case of causal
redundancy in which a cause $C_1$ prevents the action of a second cause $C_2$ having the predictable same effect $E$.

The case study offered by the well known example of the thirsty traveller gives the ground for a discussion of
this subject, which has been recently enriched by the topic of so-called “trumping pre-emption”.

Ontology, Models, and Technological Artefacts
Pasi Pohjola

In recent philosophical studies on technological artefacts, an idea of dual nature of artefacts has been emphasized.
Although this idea of dual nature is not a novel one, recent studies have extensively developed ontological aspects
of technological artefacts. According to various authors there are two constitutive elements of technological
artefacts that can be described in terms of physical properties of objects and intentional action. In this paper,
onontology of artefacts is connected to issues discussed by C. S. Peirce under topics of abductive reasoning and
philosophy.

The intention in this paper is to develop an account of models for creating novel artefacts that includes the
creative aspect in terms of abductive reasoning. In the model developed in this paper, the ontological aspect is
discussed as preliminary conditions for reasoning involved in the process of creating artefacts. To give a thorough
account of these preliminary conditions and, thus, to relate them to abductive reasoning, the discussion in this paper
exploits ideas from Peirce’s own writings. Especially issues that Peirce discusses under his trichotomy of
philosophical disciplines are applied for demonstrating how preliminary conditions that occupy thought relate to
abductive reasoning and ontology of artefacts.

The structured tasks and arguments of this paper are: (i.) Describe the idea of preliminary conditions of
thinking through Perice’s trichotomy of philosophy; (ii.) Discuss extensively how idea of preliminary conditions of
(i.) relates to abductive reasoning; (iii.) Demonstrate the general idea of dual nature of artefacts; (iv.) Develop a
model of novel artefacts by combining together the ideas of (i.), (ii.) and (iii.). The general argument here is that
there are certain forms of description as preliminary conditions that present themselves in ontology of artefacts and
act as constructing elements of creative reasoning (described in terms of abductive reasoning) in the process of
creating novel artefacts.

Abduction and Modeling in Biosemiotics and Sociosemiotics
Augusto Ponzio

The terms ‘model’ and ‘modeling’ are used in the present text as understood by Thomas A. Sebeok and his global
semiotics. Sebeok extended the concept of model beyond the domain of anthroposemiotics connecting it to the
research of the biologist Jakob von Uexküll and his concept of Umwelt, which in Sebeok’s interpretation may be
translated as ‘outside world model’. On the basis of research in biosemiotics, we now know that the modeling
capacity is operative in all life forms.
Semiosis may be interpreted as the capacity with which all life-forms are endowed to produce and comprehend the species-specific models of their worlds. Primary modeling is the innate capacity for simulative modeling in species-specific ways.

The primary modeling system of the species *Homo is language*. Secondary and tertiary modeling systems presuppose language and consequently they are uniquely human capacities. The secondary modeling system is verbal language or, in Sebeok’s terminology, *speech*. Tertiary modeling systems are all human cultural systems, symbol-based modeling processes grounded in language and speech.

Language as a modeling device related iconically to the universe it models. This statement was on the same line of thinking as Peirce and Jakobson who both stressed the importance of iconic signs. An equally important connection can be made with Ludwig Wittgenstein’s *Tractatus*, particularly with the notion of ‘picturing’.

The mind as a sign system or model representing what is commonly called the surrounding world or *Umwelt*. The model is an icon, a kind of diagram, where the most pertinent relations are of a spatial and temporal order. These relations are not fixed once and for all but can be fixed, modified and fixed again in correspondence (a resemblance relation) with the *Innenwelt* (inner world) of the human organism. On the basis of this model that may be compared to a diagram or a map, the human mind shifts from one node to another in the sign network, choosing each time the interpretive route considered most suitable.

In abduction the relation between premises and conclusion is *iconic* and is dialogic in a substantial sense, in other words, it is characterized by high degrees of dialogism and inventiveness as well as by a high risk margin for error. To claim that abductive argumentative procedure is risky is to say that it is mostly tentative and hypothetical with only a minimal margin for convention (symbolicity) and mechanical necessity (indexicality). Therefore, abductive inferential processes are engendered in and, in turn, engender sign processes at the highest levels of otherness and dialogism.

**Reason out Emergence from Cellular Automata Modeling**

QI Leilei and ZHANG Huaxia

Proto-emergentists like Alexander (1920) and Morgan (1923) thought that emergent properties were neither deducible nor predictable at all. They must be accepted by the compulsion of brute empirical facts, with the “natural piety” of the investigators. It admits no explanation. So that, we can’t understand how emergence itself was possible from Proto-emergentists. However, at the end of 20 century, with the development of complexity science and computer science, it is possible to open the black box of emergent phenomena due to the high speed computers, the new mathematic research methods and tools, especial the discrete system dynamics.

In this paper, we construct a descriptive definition of emergence based on pluralistic ontology of levels at first, and then use Cellular Automata Modeling to express and simulate some kinds of emergent processes, such as Langton’s self-reproductive loops, Conway’s game of life and virtual ants building highways. They show how the emergent phenomena arise, and how the system emergence in the higher level be reasoned out or deviated by the simple base rules of interact of system elements and their initial conditions in lower level. Although those inferences are deductive, they are not analytic. They are “bottom to up” synthetic methods using computer simulation. There are two conditions must be met when a emergent phenomenon can be reasoned out from its low level elements and their interactional rules: (1) they must be simulatable; (2) they must be computable. But this emergent phenomenon is still possible unpredictable because of complexity and uncertainty of systems.

**Backward-Chaining vs. Contrapositives: A Case Study in Computational Abduction**

Oliver Ray

Abduction has recently been used in some Machine Learning systems as a means of enabling the learning of theoretical concepts which cannot be observed directly, but which must be inferred from indirect evidence and prior knowledge. In this context, two types of abductive proof procedure have been advocated: theorem proving techniques based on the use of contrapositives, and backward-chaining approaches from Abductive Logic Programming. This paper compares the effectiveness of these approaches using a biological case study in order to identify their respective strengths and weaknesses. Backward-chaining is shown to significantly outperform contrapositives in the example considered.
Cardiovascular and cerebrovascular disease is the most common, devastating disorder in the world, also the main medical problem of elderly people due to its high morbidity, mortality and disability. Hypertension and atherosclerosis are accepted as the mainly reason and risk factor of cardiovascular and cerebrovascular disease, but pathogenesis mechanisms of them are still unknown; therefore, there is no generally accepted effective therapy for cardiovascular and cerebrovascular disease up to now.

By means of systemic scientific theory, we set up a mathematic adjusting model of circulation system, based on the physical structure, biological information regulation and blood hydrodynamic formula. The important parameters of this model include blood flow quantity (Q), blood pressure (P), artery diameter (r), viscosity (η). Using this model, the physiological and pathophysiological situation of vascular system could be simulated, the process of hypertension and atherosclerosis could be analyzed, sequentially, the reason and mechanism could be postulated. It might provide a good theoretical model for prevention and cure of cardiovascular and cerebrovascular diseases in different phase.

How Are Models Conveyed in Diagrams, Gesture, and Language?
Barbara Tversky

We asked people to explain how to get from here to there or how to put together a piece of furniture, using diagrams or gestures or speech. Participants' explanations were attempts to create mental models of the structures of the route or object as well as the actions required to create them. There are parallels and also differences in the syntax, semantics, and pragmatics of the three media.

Cognition, Types of “Tacit Knowledge” and Technology Transfer
Riccardo Viale and Andrea Pozzali

The concept of “tacit knowledge” is widely used in economics literature to refer to knowledge that cannot be codified and cannot be treated as “information”. As the usage of the term grows, so do the number of critics that consider much of the debate around “tacit knowledge” as lacking in both analytical precision and empirical content. If we want the concept of “tacit knowledge” to be really useful as a tool to develop better explanations of economical and social phenomena, a clear foundation of it is needed. Under a purely epistemological point of view, tacit knowledge can in fact have many different forms. The distinction of knowledge in three broad categories (competence, acquaintance and correct information), which is commonly used in epistemology, holds for tacit knowledge too. Different types of tacit knowledge can be learned and transferred in different ways and therefore can play different roles in technology transfer processes.

The Application of Bayesian Inference to Automatic Semantic Annotation of Videos
WANG Fangshi, XU De, and WU Weixin

It is an important topic that automatically extracting semantic concepts from a video shot. High level semantic information can improve the performance of video retrieval. In this paper, we show a way using high level semantic information to improve the performance of video retrieval. Works reported in literatures focus on annotating a video shot with only one concept using classification. In fact, one concept can not summarize a video shot with rich contents completely. Even though some methods can annotate a shot with more than one concept, they have not considered the different importance degrees of several concepts coexisting in the same shot. We have developed a novel approach to annotate a new video shot automatically with more than one concept. The first step is to annotate the first concept for a new video shot by classification. In order to improve the accuracy of classifier, we introduce a new concept “the semantic importance degree” and propose a novel method to compute the centers of the semantic concepts with considering the different importance degrees of several concepts coexisting in the same shot. The second step is to determine whether other concepts exist by Bayesian inference. Experimental results show that the performance of automatically annotating a new video shot is significantly improved using our method, compared with classical classifiers such as Naive Bayesian and K Nearest Neighbor.
Model-Based Reasoning in the Diagnosis of Traditional Chinese Medicine
WANG Zhikang

As everyone knows, there is an essential distinction of methodology in diagnosis between traditional Chinese medicine and western medicine, but for a long time, the understanding to the diagnosis of trad. Ch. medicine has been in a blurred level. The concept of the model-based reasoning can help us to get a new and clear understanding to the reasoning process of diagnosis of trad. Ch. Medicine. In fact, an effective of is equal to a scientific discovery, in which there are a series of audiovisual model to be used during reasoning. Therefore, to study the diagnosis of trad. Ch. medicine will be helpful to understand model application in scientific discovery and advance a tactics of cognitive science that returns nature.

In the first part of this paper, I will analyze the models in the theory of trad. Ch. Medicine. In the second part, I will describe the model application during the diagnosis of trad. Ch. medicine. Finally, I will discuss, in methodology, the significance of model-base reasoning in the diagnosis of trad. Ch. Medicine.

Model-Based Reasoning in Cognitive Science
WEI Yi-dong

The paper addresses the different models and their functions in cognitive science. First, I discuss various uses and meanings of models in sciences and two kinds of functions of models as idealization and representation of real world. In cognitive science, I take cognitive architectures as cognitive models. Second, I discuss Neil Stillings’ global cognitive architecture as well as its example. Third, I focus on a few forms of cognitivist models including von Neumann model, symbol system model and production system model. Four, I argue that connectionist models are better approaches to understanding the mechanisms of human cognition through the use of simulated net works of simple, neuron-like processing units. Finally, I address four models in neuroscience, such as, different models of sensory processing, Marshall and Newcombe’s symbolic model of reading, Model of memory system, and Mishkin and Appenzeller’s model of visual memory functions. These models are approach to physical implementation, not computational approach to cognition.

Presupposition, Evidence, and Model-Based Reasoning in Science
WEI Yi-dong

There are not only presuppositions in philosophy, but also in science. Presupposition, hypothesis, evidence and logic include in the process of reasoning which begins at question. Model-based reasoning is premised on presuppositions that are based on model and come from the context by comparing different hypotheses. Scientific presuppositions have their factuality and rationality.

A Resource-Based Approach to Fallacious Reasoning
John Woods

It is widely held that a pattern of reasoning is fallacious when four conditions are met. (1) The reasoning is erroneous. (2) The reasoning is attractive; i.e., its erroneousness is unapparent. (3) The reasoning has universal appeal; i.e., it is widely resorted to. (4) The reasoning is incorrigible; i.e., levels of post-diagnostic recidivism are high. Let us call this the EAUI conception of fallacy (which may be pronounced “Yowee”). The EAUI conception has had a long history, originating with Aristotle. Fallacy theorists in this tradition have concentrated their attention on the first condition, and have tended to regard the others as more or less well-understood just as they stand. This is a regrettable turn of events. No account of fallacies can pretend to completeness as long as it leaves these three conditions in their present largely unexamined state. Worse still, an account of error in reasoning cannot proceed in a principled way without taking into account what the human reasoner’s target is and what resources are available for its attainment. More particularly, the relevant account of error must disarm the objection that satisfaction of the last three conditions is reason to believe that the first condition is not met. For a piece of reasoning that is attractive, universal and incorrigible suggests that it is not an error.

In the case of the more or less traditional list of fallacies – the Gang of Eighteen as I have called it – the above pair of observations fall into an attractive kind of alignment. Arising from it is a certain model in which all four conditions manage to be satisfied. Thus a piece of reasoning is erroneous in relation to a target that embeds a standard that it fails to meet. It is attractive, universal and incorrigible in relation to a more modest target, embedding a lesser standard which the reasoning does meet. The reason is erroneous (in relation to the higher standard) and looks good because, in relation to the lower standard, it is good. Accordingly, the identity, and
appropriateness, of a reasoner’s target and its embedded standard precede any assessment of fallaciousness. And we must take seriously the possibility that the usual run of fallacies are errors only in relation to targets that reasoners don’t usually set for themselves.

Cognitive Context and Pragmatic Inference

YAN Kunru

Cognitive context, which developed from the definition of traditional context, mainly includes propositions, knowledge scripts, psychological schemata and socio-psychological representations. The study of cognitive context, which is different from the traditional study of context, lays great emphasis on the analysis of communication participants’ mental states and cognitive processes. It structures and recognizes the context of traditional context, containing not only the study content of traditional context, but the language speakers’ hypotheses about the world and their cognitive abilities, thus a psychological construction is formed and a platform is offered for pragmatic reasoning.

Relevance Theory is a cognitive pragmatic theory accounting for language communication. It is different from Cooperative Principle. Relevance Theory puts forward the notion of Ostensive-Inferential communication, and the notion of cognitive environment regarding context as psychological construct, establishes an inferential mechanism of utterance interpretation searching for the relevance of proposition to contextual assumptions by means of non-demonstrative deduction, and enlarges the range of application of the theory from conversations only to various kinds of discourse.

According in Relevance Theory by Sperber & Wilson, context is a cognitive process; its elements are not stated, yet they are a set of changeable propositions, therefore, being dynamic is its most prominent characteristics. In Relevance, they make two fundamental claims, one about cognition, the other about communication: 1) Human cognition tends to be geared to the maximization of relevance. 2) Every act of ostensive communication communicates a presumption of its own optimal relevance. Relevance Theory provides pragmatic studies with a new unified theoretical framework.

They make utterance understanding and human cognition closely in Relevance Theory. It is very important to the coherence of utterance understanding. It is a new way for the study of pragmatic inference.

On the other hand, there are some questions not yet to be answered in relevance theory. This article means that the relevance theory calls for further development and it will lay a theoretical foundation for the further study on pragmatic inferences and the interpretation of pragmatic meaning of utterances.

Study on Logical Description of Chinese Metaphor Understanding

YANG Yun, ZHOU Changle, and ZHANG Wei

Within the last few decades, a great deal of attention has been paid to metaphor understanding which plays an important role in language epistemology and discourse understanding. The research on metaphor understanding will help the machine to reconstruct the omitted information and help people to study the cognitive attribute of natural language. But the logic system and computational method of metaphor still needs to be improved. In this paper we first give a brief introduction to the definition and linguistic foundations of metaphor and then propose a logic system of metaphor in detail. Inspired by the local frame theory we substitute possible worlds with possible-feature spaces, and introduce understanding modal operator $U_p$, the relational symbol $P$ and the Gestalt rule to our logic system. We present the metaphor logic system by giving definition of possible-feature space and first-order language of metaphor logic $L^{met}$, constructing the axiomatic system and inference rules, and analyzing the properties of the logic. A preliminary application of the logic system is also introduced in understanding Chinese metaphor, especially, in nominal and verbal metaphors. The logic system we proposed here gives a new method for Chinese metaphor understanding in natural language processing field. The main novelty of this logic is that it uses possible-feature spaces instead of possible worlds and takes account of subjective states of agent in logic analysis. The result shows that this metaphor logic has good performance to extract the meaning of Chinese metaphorical sentences and gives instructional method of machine-understanding of metaphor.

The Intentional Explanation of Action Based on the Erotetic Model

YUAN Jihong

According to the intentional explanation of action in philosophy of social science, the long-standing problem is about the relation among beliefs, desires and the action. The relation between causes and reasons and the relation between laws and norms are tightly interrelated with this problem. In discussing those relations, early naturalism argue for
Hempel about his covering-laws model, which is strongly refuted by antinaturalism. Recently, naturalism talk back those refutations based on the erotetic model. Is this approach available? This paper aims to discuss this topic.

On the basic erotetic account, an explanation is an answer to a why-question, and can be understood in terms of the logic of why-questions. The form of why-question is ‘why P rather than Q, R, ...? ’ where the proposition P is the topic and the set {P, Q, R,...} is the contrast class. The relevance relation is the sort of relation that an event or state must bear to the topical events or state (and not to other members of the contrast class) in order to qualify mention of it as an answer to the why-question. (van Fraassen 1980; Henderson 1993, 2002; Risjord 1998, 2000). This much provides a framework for understanding general explanation.

However, the basic erotetic framework is not a satisfying analysis of explanation. Until the relevance relation is given some delimiting analyse, the erotetic account can’t show it as good as the analyses that one can provide for specific classes of intentional explanation-seeking why-questions. This paper believes that on the one hand, the relevance relation implicit in a why-question is at least partially a matter of the relation of cause and effect. It means that if having explanan events or states, then more likely happened the explanandum, ceteris paribus. On the other hand, the relevance relation must show that the topic event or state should be in the conditions of the particular context and the other event in the contrast class would at least have been less likely in the conditions that obtained. It shows that there is an important factor in the relevance relation - norms of the social system that is the actor in. Description of norms is a generalization with a significant degree of invariance. This generalization has different domains in term of different social context. Invariant domain is the domain in which the topic events happen and the other events don’t happen, ceteris paribus, and the why-questions are available to the particular social context.

So the conclusion is that fetching norms in the erotetic model may let naturalism to discuss directly intentional factors, and to talk back antinaturalism availably.

**A Tentative Reasoning Logic System of TCM Yin Yang and Five Elements**

ZHOU Changle, JIANG Minjun, ZHANG Zhifeng,  and XU Jiatuo

In the field of traditional Chinese medicine (TCM), the theory of yin yang and five elements (WuXing) is very broad and extensive, which is not only the theoretic basis of TCM syndrome differentiation and treatment variation but also the principle to instruct the clinical diagnosis and treatment. Therefore, the theory is of great value for TCM in both theory and practice. However, for many years, the lack of the research on the strict formalization of this theory makes it hard to come up to the development of modern TCM. But still we are able to establish a reasoning logical system of yin yang and WX corresponding to the principle of TCM diagnosis by using some advanced logical thoughts and methods such as paraconsistent logic and default logic, which can be used to describe the basic reasoning procedure of TCM syndrome differentiation. Of course the system presented in this paper is far from perfect, but through the analysis of a specific diagnosis case it can be shown that the describable ability of the system is quite satisfactory.

**A Model-Based Cognitive Approach to Technological Explanation**

ZHOU Yan

One of the core issues of epistemology of technology is technological explanation which is different from scientific explanation. Technological explanation consists of explanation of technological action, rule of action and structure and function modes of description of technological artifact. I will present an account on difficulties of technological explanation within traditional explanation model frame: (1) Technological explanation involves in pragmatic syllogism based on intention and belief. The actual kernel of technology must include goals, purposes. The explanation of technological action involves reasoning between belief/desire and action or goal-means relation. The relation of goal-means can’t be deductively inferred from desire/belief sets. The so-called means, and is known to be, an insufficient but necessary part of a condition which is itself unnecessary but sufficient for the goal. (2) The relation between structure and function of technological artifact is also not of a logical-deductive character. Technical artifacts have a dual nature: structure and function nature. A technological design consists of a technological explanation, i.e., an explanation of the function of a technological object in terms of the physical structure of that object. From structure in a logically deductive way to the function of the object is not possible because the same physical phenomenon can be, depending on the context, a means to quite different ends.

It should be claimed that the explanation of pragmatic syllogism can’t be satisfied by deductive-nomological model, statistic explanation and causal explanation. Implicit representation and procedure knowledge also should be involved to this process. I attempt to account for technological explanation within a model-based framework. It can be claimed that model-based reasoning can transform causal relations into goal-means relations by applying goals to a knowledge about regularities in nature and society A successful technological explanation can be got by rational evaluating between goal-means relation and a designed structure performing a certain function. This paper will give a description on modification for MBR.