Round tables abstracts

Round table 1

Computational models for simulating cognition and behavior: reflections on its methods, scope, and underlying epistemology

Diego Zilio (UFES – coordinator)
Flávio Soares Correa da Silva (USP/IME)
Leonardo Lana de Carvalho (UFVJM)
Luciano Silva (U.P. Mackenzie)

a) On the Different Sorts of Artificial Intelligence: Deep, Shallow and Mimicking

Flávio Soares Corrêa da Silva
(Department of Computer Science – IME – University of São Paulo)

The field of Artificial Intelligence (AI) as we know it today started in 1956 in the United States, as an initiative of J. McCarthy and colleagues. It was planned to be multidisciplinary and has always aimed at the study of Intelligence through its reconstruction in human designed platforms. Around the same period and location, the field of Human-Computer Interaction (HCI) started to be structured around the notion of *Human Augmentation* proposed by D. Engelbart, among other scholars. For several years, AI and HCI were developed by separate, nearly disjoint research communities, carrying conflicting views about the most appropriate ways to bring together humans and digital/computational machines. Along the history of AI, some initiatives have taken the road of foundational scientific endeavor, while other have focused on the appropriation of techniques inspired by biological phenomena to design and build useful artifacts. Within the AI research community, some scholars have named the former initiatives *Deep AI*, and the latter *Shallow AI*. Deep AI refers to attempts and initiatives to isolate Intelligence as an observable phenomenon, and to build a deeper and broader understanding of this phenomenon through model building and simulation in man-made substrates. Shallow AI, in contrast, emphasizes the potentialities of techniques that emerge as a result of observing biological systems whose behavior can be deemed *intelligent*, as tools to build artifacts that, based on some appropriate metrics, can be considered improvements on previously existing artifacts for similar functionalities. A third possible road, in which digital artifacts could be designed to *mimic* intelligent behavior convincingly, was initially viewed as a road to be avoided, as the results of initiatives built this way could be taken as forgery and potentially unethical behavior. Recently, however, interesting methodological evolutions have taken place, aligning the fields of AI and HCI and clarifying that Deep, Shallow and Mimicked AI were not, in fact, as different as initially considered. By taking a more encompassing (and hence significantly more challenging) design stance, one can consider the design of social systems comprised by digital/computational artifacts as well as human participants. Such systems - frequently coined *Social Machines* - should be structured in such way that digital components are programmed and human components are incentivized effectively to cooperate. In order to build high quality social machines, one needs to build appropriate interaction networks and protocols; program the behavior of digital components based on well grounded (*deep*) models of intelligence; make sure that these models are computationally efficient (hence implemented according to the precepts of good *shallow* models of intelligence) and, finally, make sure that digital components can be perceived by human components as intelligent, so that social interactions can occur with the required fluidity. As a consequence, *mimicked* intelligence has been accepted as a third facet

of intelligence that is required to build digital devices which may deserve to be accepted as intelligent in social interactions.

b) Emergent Signs, Enactive Cognition and Complex Systems

Leonardo Lana de Carvalho
(PPG Ciências Humanas, Universidade Federal do Vale do Jequitinhonha e Mucuri, Diamantina, MG)

We emphasize that any form of naturalization of phenomenology will be widely different from pure phenomenology. The concept of enaction would provide a natural alternative, strongly connected with biological scientific thinking and inspired by phenomenology, to explain cognition. The living being is presented to be a producer of itself. This is only possible with beings that produce the conditions of their own existence. The environment modifies or perturbs a structure whose function keeps this structure. In this sense, the living entity is described as a history of perpetuating in the world that takes place through its structural coupling and its operational closure. The evolution of the species occurs by means of a natural drift. The source of intelligence is the body in action, and we stress that the nature of cognition is to be in action ("en acción"). If a system is self-organized, structurally coupled in an environment, their actions are adaptive; these actions are intelligent in this environment. In this sense the theory of enaction do not need the concept of a "res cogitans" or "mental representation" to explain cognition. On the other hand, forms of material representations have been proposed by other theories in cognitive science with great success in modeling and synthesis of intelligent systems. The purpose of this paper is to defend a promising possibility of theoretical and practical alliance between the enactive theory of cognition and consistent notions with this theory of "information", "representation", "sign", etc. In our view, the key concept of this alliance is that of the emergent sign. The enactive approach received significant influence from connectionism, especially regarding the concepts of self-organization and emergent properties. The connectionism has sought solution to the problem with the concepts of microrepresentations (material symbols manipulated by the machine) and macrorepresentations (emerging patterns from the material symbolic activity in interaction with the environment). Maturana and Varela argue in this sense that "… interactions (once recurring) between unity and an environment consist of reciprocal disturbances. In these interactions, the environmental structure only triggers structural changes on autopoietic units (do not determine or inform), and vice versa for the environment." We argue that the main influence of enactive theory in computational thinking is the renewal of artificial intelligence that explores the concept of enactive theory. However, the overcoming of the "problem" of "enaction" versus "representation" means the introduction of a new paradigm in cognitive science, the complex systems paradigm to cognition. Steels begin to signal the transition from the enactive theory to the complex system theory of cognition. His work on the development of language, such as "Language as a Complex Adaptive System" from 2000, presents language as emerging from a complex network of interactions, conceived from the interaction of agents with their environment. We understand that another important article was published in 2003, titled "Intelligence with representation". In this paper, the author opposes Brooks, explaining that a semiotic notion of representation should be maintained. Mitchell (1998), in the article "A complex-systems perspective on the 'computation vs. dynamics' debate in cognitive science" argues that; "Most of these theories assume that information processing consists of the manipulation of explicit, static symbols rather than the autonomous interaction of emergent, active ones." We argue that enactive cognitive agency must contain an algorithm that should not be a reinforcement function, nor a problem-solving algorithm consisting on deduction and inference functions. Indeed, the construction of a world is sought as a way of being in the world.

Using Dreyfus's term, a "skillful coping" algorithm, or an autolelic principle. The agent would not be getting an input i or a reinforcement s, but the inputs would be better described as perturbations. Our point is that these perturbations lead to an internal building B that is, from the perspective of the history of the system, the effect of the agent coupling with the environment. This kind of B building block can be useful to the agent for reprogramming itself, its own algorithm (self-programming). According to Rocha & Hordijk (2005), this B can serve to guide the development of complex adaptive systems, such as a biological organism that makes use of its genetic code to guide its development. According to Steels (2003), this B can also be useful to agent architectures as signs in semiotic relationships under the aegis of cross or multi-scale levels of structural coupling processes. We stress the importance of enactive approach in the design of agents and agents as artificial autopoietic beings, understanding that previous approaches have very different cognitive architectures and that a prototypical model of enactive cognitive architecture is one of the major challenges today. Indeed, this is a sensitive matter and we would not have the space here to address this issue properly. However, we would like to notice that nowadays, it is an aspect that divides the community in embodied cognitive sciences, and it may even be signalling a transition to a complex systems theory of cognition. Crutchfield (1994) understands that new machine models are required to investigate the emergence and complex systems. According to the author, the complex systems approach of the computing machine consists of a particular notion of structure. The complex machine structure would be based on a "nonlinear mechanical computing processes". This malleable structure can be modified by means of mechanisms for transformation of the structure. These mechanisms of transformation would lead to a constant "reconstruction of the hierarchical machine" by itself. To connect the structural reconstruction processes, Crutchfield provides "evolutionary mechanics". Then, he suggests that this complex machine should be the standard model for the study of complex systems and emergence. Conclusively, we support that any cognitive agency to have enactive bases must actually conceive agent's structures as coupled to the environment. An autopoietic machine should be able to pass through natural drift. However, the constructions of complex machines need a coherent theory assimilating the concepts of enaction and material representation. We think that this theory is based on the concept of emergent signs or similar notions. Following Fodor (2000), perhaps the investigation of this reality is not interesting for some cognitive engineers. However, this research is profoundly important to cognitive science and philosophy of the mind. We argue that technological applications will surpass the expectations.

c) Algebraic Semiotics for Specification of Cognitive Aspects in Human-Computer Interaction

Luciano Silva
(U.P. Mackenzie, São Paulo)

In Human-Computer Interaction (HCI), there is a constant need for understanding the mechanisms of human perception linked to the interaction process with computers, whose result may yield important information for specifying and building interfaces with better usability and learning measurements. If communication processes with the interface are not accordingly planned with the observation of human factors, one may generate common problems such as difficulty in locating desired tasks as well as a long time and way to complete them. For example, the presence of functions that are not used and others not available, joined to the difficulty to remember the route to the tasks may compromise indices associated with the evaluation of an interface. Techniques of Cognitive Sciences can be used for the improvement on interface Project. They provide a mental user model which can be exploited to observe the intensity of requests from processes cognitive derived from users (experience, interpretation, memory and learning). One of the recurring problems in using these mental

models is how to model them formally in such a way to promote their inclusion as components in the formal specification of an interface or in evaluation procedures. There are several approaches to this problem and Algebraic Semiotics has offered a viable environment not only for representing cognitive issues on interfaces but also to integrate them in evaluation procedures based on formal methods. Algebraic Semiotics provides a framework for quantitative and qualitative analysis of interfaces, design criteria for creating interfaces and a strong relation to dynamics algebraic semantics. Using a system of signs, the Algebraic Semiotics can address various cognitive aspects in an interface through precise algebraic definitions for sign system and representation, calculus of representation with laws about operations for combining representations and precise ways to compare quality of representations. Moreover, it is possible to extend the constructions of Semiotics Algebraic to include dynamic signs for user interaction (e.g. Hidden Algebra), combination of algebraic structures with Gibsonian affordances, narrative structures, social foundations, computational semiosis and choose ordering on representations.

d) Explaining Psychological Phenomena: The Role of Experimental and Artificial Simulations

Diego Zilio
(UFES – Federal University of Espírito Santo, Vitória, ES)

What is the role of simulation in explaining psychological phenomena? My goal in this talk is to discuss this question. I will start by analyzing the definition of "simulation" as representation through models. Two possible ways of simulating psychological phenomena arise from this definition: (a) simulation as experimental models usually adopted in experimental psychology in the study of human and non-human behavior; and (b) simulation as artificial models used in cognitive science aiming the implementation of cognitive processes in machines. Both alternatives will be discussed in the light of a biological oriented mechanistic conception of explanation. I will argue that experimental simulations are essential to the construction of psychological knowledge and must precede artificial simulation when possible. Artificial simulations, on the other hand, have at least two main functions: to contribute to the validation of the knowledge produced by experimental simulations and to create useful technologies aiming the resolution of human problems.

Round table 2

ICT and Society: Ethical issues on the influences of ICT in individuals' daily life

Arturo Forner Cordero (POLI-USP)
Guiou Kobayashi (UFABC)
João Antonio de Moraes (UNICAMP – coordinator)
Mariana Claudia Broens (UNESP/Marília)

a) Common spontaneous action in the context of the new informational technologies

Mariana C. Broens
(Department of Philosophy, State University of São Paulo, UNESP, campus Marília)

The objective of this communication is to investigate possible implications of the new informational technologies in human common action, especially in spontaneous actions of everyday life. In order to do so, I will characterize common spontaneous action as the result of the information offered by affordances present in the environment (GIBSON, 1986), without the need of mediation by mental representations. Following I will analyze possible difficulties to the cognitive modeling of this kind of action. Finally, I will discuss pragmatic implications in common spontaneous action of the generalized use of the new informational technologies, like Internet of Things, currently mediators of a meaningful part of human interactions in industrialized societies.

b) Ubiquitous systems and Internet of Things, and their impact on society and personal life

Guiou Kobayashi
(Federal University of ABC, UFABC).

Internet of Things (IoT) is a scenario where devices like sensors, actuators and other real world objects are connected over a network (like the Internet), with the capacity of exchange data with computer systems without necessarily requiring human intervention. Some of these devices are ubiquitous (as defined by Mark Weiser), meaning that they are designed to interact with humans, and others are pervasive and embedded in the environment and in the everyday objects and machines. With IoT, it will be possible for the computer systems to interact with the real physical world, including people, machines, and the environment. Sensors and actuators will provide feedback to the systems built for specific purposes (*purposeful systems*), allowing these systems to measure the effectiveness and efficiency that their actions have in the real world. It will be possible to develop systems intended for the purposes of *persuasion* for example, (improvement of *suggestion* systems already in use in e-commerce), with actions on real world provided by IoT. The improved data availability and accuracy, coupled with database integration capabilities and data mining might enable finer adjustment of the actions. IoT raises a new level of privacy and ethical concerns. Despite the widespread use of smartphones in industrialized societies, it is still possible to turn these devices off or disconnect them from the network. With IoT technology, however, the sensors might be everywhere and they might always be turned on. In this case, it will *not* be possible to disable them, because individuals are not the owners of the devices. Who owns the data collected by IoT in public places? How, and by whom, will the data be used? In today's scenario, where a small number of Internet companies (Google, Microsoft, Facebook, etc.) can access all the available data on the net, these questions must be analyzed seriously.

c) Robots for care and assistance ethical implications in the ageing society

Arturo Forner Cordero
(Biomechatronics Lab, Mechatronics Department, Politechnic School of University of São Paulo, USP).

There are several ethical and legal issues (BOGUE, 2004a, 2004b) regarding the development and deployment of robots. In particular the military robots and more recently drones have received a lot of attention due to the ethical implications of their operation. An emerging area of robotics research focuses on service robots oriented to provide care, help, assistance, rehabilitation or training to the human user. In this group some authors include companion or pet robots such as Paro or Aibo. However, in my opinion, they must be considered separately due to the emotional problems they may elicit. In care robot design and the human-robot-interface there are two main ethical issues that are already well established: safety and privacy. For instance, in a class of care robots, such as exoskeletons, that have a strong physical and cognitive interaction with the user it is necessary to define safety mechanisms at several levels of the design. At the mechanical level there could be passive safety elements: including mechanical stops at the joints to prevent going beyond the range of motion of the subject or active: limiting the maximal forces/torques applied by the actuators. At the control level systems like impedance control or limiting functions can be used to avoid the generation of large torques, velocities and accelerations that could compromise the safety of the subject. Privacy is another issue already solved: as the robot gathers lots of information about the human user it is possible to have a privacy problem. This issue is commonly addressed in the Institutional Review Boards with respect to data obtained from experiments and the same solution can be applied to care robots. Departing from the obvious ethical problems, it is possible to include some methodology to integrate ethics into the design of exoskeletons (SULLINS, 2015). This methodology includes the evaluation of different aspects of the exoskeleton and its expected mode of operation. The practice and context of operation, the actors involved along with their levels of responsibility, the type of robot (rehabilitation, assistive, enabling) and the possible moral elements involved (WYNSBERGHE, 2013). This type of methodology will be presented with a case study about a lower limb exoskeleton designed to assist biped gait of paraplegic patients.

d) ICT, society, and the emergence of the *hybrid beings*

João Antonio de Moraes
(PhD Candidate of Philosophy, Institute of Philosophy and Human Sciences, State University of Campinas, UNICAMP).

Because of the increasing presence of ICTs in the individuals' daily life, new ways of being-in-the-world are emerging, changing current habits and influencing the way that individuals act and understand themselves in the world, both in relation to other individuals and to their environment. The Internet stands out as a catalyst to digital being-in-the-world. One of the most noteworthy and prominent changes associated with the influence of ICTs over individuals is in terms of communication, where individuals, who were until recently only receivers of information, have now become producers of information for a global network. In doing so, the new communication paradigm changes one's conception of the world and they become both actor within, and catalyst to, an immersed digital environment, thus constituting a bottom-up movement that is decentralized, an environment by which users are active participants. Beyond the communication aspect, there is a naturalization of new forms of action

in the world in the process of digitalization, much like there is in any new dynamic of society where ICTs is more then tools. As Capurro (2010) remarks, “The view of computers as something ‘other’ is disappearing, i.e., they are less and less ‘some-thing’ or ‘other-than-us’ and permeate the world in which we – or, more precisely: some of us – live”. Moreover, with the development of ICTs and the disappearance of the boundary between physical and digital worlds, there is a direct influence of ICTs in the personal identity of individuals, where “in designing tools we are designing ways of being”. As expressed by Ihde (2004), there is a change in the life-world texture. With the notion of ICTs as “technologies of the *self*”, Floridi (2014) believe that ICTs has promoted changes in the self-undertanding of individuals within the world, in his/her relation to the others and his/her environment. In Floridi’s (2014) words: “The self is seen as a complex informational system, made of consciousness activities, memories, or narratives. And since ICTs can deeply affect such informational patterns, they are indeed powerful technologies of the self”. From such understanding, once you have new possibilities for action, and expressions within the world by individuals, there are new ways for influence and change individuals’ self-understanding. What little analysis has been offered towards understanding the influence that ICTs have had on the behavior and self- understanding of individuals and has been thus far largely restricted to user groups that include children and teenagers, namely the so-called Generation Z (“Z” in correspondence to zettabytes, the amount of information generated before 2010; GANTZ & DAVID, 2011). These individuals, often called “digital natives”, have never known access to a world without the presence and persistent influence of Google, Twitter, Wikipedia, and Facebook, where such terms are understood not as merely services but as verbs (FLORIDI, 2014). Generation Z was born into, and raised, surrounded by ICTs, and all of the above ‘novelties’ of information and communication are rendered through natural actions in the case of digital natives. It is in this scenario that we will argue that the *hybrid beings* appear as a result of the influence the dissemination of ICTs in individuals’ daily life, promoting the naturalization process and of the digitalization of the world, executing two expressions of the same world. As Moraes & Andrade (2015) argues the hybrid being is characterized by his/her ability to act without strangeness in a context in which ICTs are disseminated. Thus, action and an individual’s own personal identity is reinterpreted via mediation of ICTs, and this already becomes a part of his/her own existence. In other words, the hybrid being is the result of a process of an informational reinterpretation promoted by the inclusion of ICTs in the daily life of individuals, expressed in physical/digital dimensions. Questions on the characteristics and performances of *hybrid beings* in the world will also be discussed.

Round table 3

Advances and Perspectives in Cognitive Architectures

Ricardo Ribeiro Gudwin (UNICAMP – coordinator)
Márcio Lobo Netto (USP/Poli) / Mauro Muñoz (USP/Poli)
Angelo Conrado Loula (UEFS)

a) Toolkits or Frameworks : What is the Best Approach for Deploying a Cognitive Architecture?

Ricardo Ribeiro Gudwin.
(DCA-FEEC-UNICAMP - Department of Computer Engineering and Industrial Automation - School of Electrical and Computer Engineering - University of Campinas)

Artificial Minds are a special kind of control system for an autonomous agent, inspired in the functions and characteristics of animal or human minds. Cognitive Architectures are both theoretical models of artificial minds and software implementations of these models. Currently, there are many different cognitive architectures reported in the literature (see e.g. http://bicasociety.org/cogarch/architectures.htm for a comparative table of at least 26 different cognitive architectures), and some of them have their code available for sharing with the community. This code is available mainly in 2 different options, depending on the cognitive architecture: Toolkits or Frameworks. Cognitive Toolkits are a special kind of software library, where different versions of cognitive functions are provided as a repertoire of classes, which can be combined and used together in many different ways, and the overall behavior of the cognitive architecture will depend on the features chosen by the toolkit user in order to fully implement his/her specific cognitive architecture. Cognitive Frameworks, on the other side, are reusable software environments providing a complete implementation of a cognitive architecture, which are configurable in order to enable or disable specific cognitive features and capabilities available in the framework. Cognitive Frameworks contain some distinguishing features that separate them from Cognitive Toolkits: (a) *inversion of control*: in a framework, unlike in a toolkit, the overall program's flow of control is not dictated by the caller, but by the framework - the framework calls your code, not the opposite; (b) *default behavior*: a framework usually has a default behavior, which provides a basic set of cognitive functions to be used by the architecture if no additional configuration is provided;.(c) *configurability*: a framework can be configured and extended by the user, which might choose among alternative ways of providing a given functionality or provide additional functionalities not originally present in the framework.; (d) *non-modifiable code*: the framework code, in general, is not supposed to be modified, while accepting user-implemented extensions. In other words, users can extend the framework, but should not modify its code. The construction of a particular cognitive architecture suitable to a specific application (or a specific agent), will require different programming modes. In the case of a toolkit, the overall architecture will be set up by using the toolkit classes in order to perform a bottom-up construction process which will result in the final architecture. In the case of a framework, usually this construction is a top-down approach. There is a single point of contact with the framework's code, usually creating just a single object from the framework, and giving the control to it. All the user programming will be in providing extension classes which are plugged-in to the framework code and providing a configuration, usually by means of external files (e.g. XML or text files) providing the configuration information. In this work, we will present some concrete examples of toolkits and frameworks provided by different cognitive architectures, and will discuss the advantages and shortcomings of each of these programming modes, with the aim of building up a cognitive architecture for a specific application.

b) On the Emergence of Representational Processes in Communicative Cognitive Agents: Experiments and Analysis

Angelo Conrado Loula
(Intelligent and Cognitive Systems Lab - Universidade Estadual de Feira de Santana, UEFS)

Representations are a topic of interest in Artificial Intelligence (AI) since its foundation and remains as an important issue in current research. The initial concept that intelligent systems are capable of reasoning based on representations, following a formal logic approach to cognition, brought together a question on what such representations would be, an ontological issue, and a question on how they could be produced and interpreted, an epistemological issue. But the first answer was limited to determining the appropriate data structures, in a merely technical perspective, and on how to collect and insert data that would represent the knowledge on which inferences would be applied and new knowledge would be obtained. This lead to several criticisms, such as the Symbol Grounding Problem, that essentially challenged how something could actually represent something else for an intelligent system, and not only to the designer that provided the data to the system. On the other side, the so called Nouvelle AI proposed a new approach for intelligent systems, committed to situatedness and embodiment of cognition. In these new systems, embodied artificial agent are situated in an environment, establishing sense and act loops and interacting with other agents. Agents would build its cognitive competences as a consequence of its history of sensory-motor cycles and interactions, based on learning, adaptation and evolution. Nevertheless, there was a refusal to deal with representations in this new approach, maybe considered as a minor or unnecessary trait. Meanwhile, more recently, there has been a great variety of research on the emergence of communication and language among artificial agents, robotic and simulated ones. As a methodological principle, the cognitive or social process of interest is not previously present in a community of agents, but by means of interactive and adaptive processes it can emerge among the agents. But, even though communication and language are strongly related to representational processes, there has been little or no discussion on this issue in such research works.Based on the fact that communication can be seen as the production (by a speaker) and the interpretation (by an interpreter) of representations, it is fundamental to understand the characteristics and conditions for the emergence of diverse modalities of representational processes, associated with communication and their relation to other cognitive traits. As such, we take the research scenario on the emergence of communication in a community of artificial agents as a particularly relevant framework to study underlying representational process. We propose to present an approach to study representations in communicative cognitive agents, based on theoretical principles from C.S.Peirce semiotics, including a description of cognitive architectures that fulfill minimal requirements to implement representational processes. We also describe computational experiments involving the emergence of communication and representations, with an analysis of internal mechanisms of the agent's cognitive architecture, representation processes and evolutionary dynamics.

c) Issues in Artificial Cognitive System Architectures

Mauro Muñoz & Márcio Lobo Netto.
(Escola Politécnica - Universidade de São Paulo)

An important issue for artificial cognitive systems is how they deal with the problem of Symbol Grounding (SG) firstly pointed out by Harnard who recently reformulates it as: it ``is the

problem of causally connecting symbols inside an autonomous system to their referents in the external world without the mediation of an external interpreter''. The SG problem motivated Taddeo to establish the zero semantical commitment condition (ZSCC) for cognitive system designs as: "a) no form of innatism is allowed; no semantic resources (some virtus semantica) should be presupposed as already pre-installed; and b) no form of externalism is allowed either; no semantic resources should be uploaded from the 'outside' by some deus ex machina already semantically-proficient.". Other important issue for an artificial cognitive system is its capacity to adapt itself to unknown situations. As a consequence the system architecture should be capable to expand its own cognitive structure. This capacity is captured by the Autonomous Mental Development (AMD) paradigm proposed by Weng: "With time, a brain-like natural or an artificial embodied system, under the control of its intrinsic developmental program (coded in the genes or artificially designed) develops mental capabilities through autonomous real-time interactions with its environments (including its own internal environment and components) by using its own sensors and effectors. Traditionally, a machine is not autonomous when it develops its skills, but a human is autonomous throughout its lifelong mental development." Facing those artificial cognitive system design issues the Piaget's theory about the human intelligence development seems not only to fulfill those premises, but also pointing to architectures based on the bottom-up cognitive complexity approach. Particularly, Piaget named as sensory-motor stage the initial development period. This stage prepares the cognitive apparatus to be capable to deal with symbols in a latter stage. Thus no symbolic representation or symbol usage by the apparatus is assumed by the sensory-motor development theory. The conformity of the piagetian theory with the ZSCC and the AMD seems to show a promising path to construct guidelines for cognitive system architectures focused on bottom-up approaches. When thinking in a cognitive system architecture from the bottom-up approach a new question arises: how a system interacting with its external environment exclusively through its sensory-motor signals can start to interact to the entities it imagines to be the cause of the signals it perceives and be affected by the actions it generates?

The basis for an artificial autonomous cognitive development systems architecture designs capable to extrapolate from signals interaction to object-concept interaction seems to be a relevant open issue.

Round table 4

Information, Context and Structure in Cognition.

João Eduardo Kogler Junior (USP/Poli – coordinator)
Marcos Fernando Lopes (USP/FFLCH).
Paulo Eduardo Santos (FEI).
Renato Teodoro Ramos (USP/FM).

a) Information: a claim for meaning

Renato Teodoro Ramos.
(School of Medicine – Department of Psychiatry - University of São Paulo).

The objective of this presentation is to discuss the concept of meaning in information theory from a neuro-cognitive perspective. This topic is of special interest for neurosciences because several neurological and psychological models conceive human brain as an information-processing machine. These approaches implicitly suggest a parallel between brains with other devices, like computers, for which the concept of information was developed. The seminal Shannon's proposal of informational entropy is a good example of this approach. In this model, the concept of information is related to the probability of occurrence of a given message in a communication system constituted by information source, transmission channel, and receiver. The main limitation for the use of this model for studying brains and behaviors is the assumed irrelevance of the message meaning. How information acquires meaning is a very complex question associated to the definition of semantic information. Despite the lack of consensus, semantic information has been defined in function of "well-formed, meaningful, and truthful data". What is not clearly stated in these semantic approaches is that the process that defines information as something significant occurs in the receiver component of the Shannon information system. The following propositions will be discussed: - The meaning of a message emerges in the receiver and any other stimuli running through the information system that is not capable of modifying the receiver's state is not information at all. - A measure of semantic information is essentially a measure of influence between agents. - The validity of a message is not a property of isolated agents or of the message itself. The ascription of trueness of information depends on the selection of influences according to some criteria. In biological systems, like human brains, evolutionary processes has imposed utilitarian constraints to select informational contents. - Brains "use" information to construct representations, predict future events, and improve survival chances. - The sophisticated psychological constructs classically associated with the concept of mental representation are essentially of the same nature of interactions of simple biological or computational elements.

b) Dictionaries' Core Defining Words Are More Frequent and Have More Meanings

Marcos Fernando Lopes
(Department of Linguistics, FFLCH, University of São Paulo).

From a dictionary's graph of defined and defining words one can compute a Grounding Kernel (Kernel) (about 10% of the dictionary) and Kernel Core (Core) (about 70% of the Kernel) from which all the rest of the words can be defined (Massé et al., 2008; Picard et al., 2009). For the Longman Dictionary of Contemporary English, several of the lexical semantic properties of

the Kernel (and especially the Core) words differ significantly from the rest of the words in the dictionary. Other studies had shown that these words are learned earlier. Focusing exclusively on nouns, we now find that they have more senses, are more frequent in written corpora, more familiar, and more similar to one another internally. These emerging special properties of the Kernel and Core may cast some light on why the meanings of the rest of the words in the dictionary are grounded in this small subset from which they can be reached through definition alone. The present work was written in collaboration with: Alexandre Blondin-Massé, Mélanie Lord, Odile Marcotte, Philippe Vincent-Lamarre (Université du Québec à Montréal) and Stevan Harnad (Université du Québec à Montréal and Canada Research Chair in Cognitive Science).

c) Slicing Space with a Semantic Knife-Edge

Paulo Eduardo Santos.
(Artificial Intelligence in Automation Lab., Department of Electrical & Electronics Engineering – Centro Universitário FEI.)

The aim of this work is to investigate a representation and reasoning formalism capable modeling the vagueness, polysemy and ambiguity present in spatial descriptions of scenes using natural languages. The absence of precise specification (or vagueness) is present in various terms used for spatial descriptions, for instance, one of the first term a child learns to describe its environment (that is also a term that occurs is all languages [2]), the spatial demonstrative "that", expresses no precise location, apart from saying that the object in question is further from the speaker. The second issue of interest here (polysemy) is a characteristic of any natural language, since there are fewer spatial relations to express a large range of situations in any of the existing languages [3]. Finally, ambiguity can be exemplified by recent research on cognitive psychology that indicates that, in everyday human communication, people mix perspectives without signaling to the interlocutor [6]; besides, sketches of scenes constructed from verbal descriptions not always agree with the actual described scenes [4]. These issues are overlooked most of the time by human agents in normal speech, in fact they seem to be part of our understanding of the world. It may be the case that scene understanding from verbal descriptions presupposes the existence of a kind of constraint satisfaction and model building system in our minds that solves possible the inconsistencies in spatial descriptions. The development of algorithms for constraint satisfaction in spatial domains is at the kernel of the development of spatial algebras [5], that is within the interests of Qualitative Spatial Reasoning (QSR) [1], a subfield of Knowledge Representation in Artificial Intelligence. The aim of Qualitative Spatial Reasoning is to provide rigorous logical formalisms for the representation of spatial relations from elementary entities using qualitative relations. However, these formalisms are built upon very abstract notions that have no relation to the actual use of spatial expressions in natural languages. An opportunity thus emerges to investigate the construction of a QSR formalism whose semantics is capable of handling vagueness, polysemy and ambiguity, as present in the natural language descriptions of scenes. In order to construct such formalism we need to, first, list and compare the various findings from cognitive linguists that point to the way spatial expressions are used in common languages; second, find a common structure underlying our understanding of spatial expressions and, third, describe this common structure as an algebraic structure that provides the semantics for the spatial relations in a QSR formalism.

d) Geometry, information and action in the explanation of cognitive and perceptual processes

João Eduardo Kogler Junior.
(Polytechnic School of Engineering, Department of Electronic Systems, University of São Paulo)

Cognitive and perceptual processes are considered here as transformations operating on sensorial and internal data in order to detect and extract information useful for prediction for immediate or future use in the modulation of decision processes that generate actions. In this work, we argue about the role of invariants under such transformations relating them to context, in the search of a geometrical explanation for the relational structure underlying the mutual constraining among interacting components participating in the inferential mechanisms embedded in a cognitive/perceptive agent. The encoding of information and knowledge is related to this geometry, which will be claimed to meet requirements imposed by the interfaces between the agent and the external world, essentially concerning to its adherence to affordances, in the sense of the situated cognition paradigm. Some questions and issues related to this view will be discussed, considering the role of evolutionary and developmental processes as of paramount importance in the construction of this theoretical approach for explaining some aspects of cognition.

Round table 5

Machine Learning and Pobabilistic Modelling of Cognition and Behavior

Edson Satoshi Gomi (USP/Poli)
João Ricardo Sato (UFABC)
Nestor Caticha (USP/IF)
Peter M. E. Claessens (UFABC)

a) Why Bayesian Modeling?

Nestor Caticha
(Instituto de Física University of São Paulo)

Once we decide to model cognition using mathematics the natural question that emerges is: among the many mathematical structures at our disposal, which should be used? Cognition is a typical situation of incomplete information, since just as an example, sensorial information arises from just a subset of the possible information about the external world. It might happen that several possible states of the real world are compatible with the sensorial state. A few common sense demands lead to a mathematical structure that includes the theory of probabilities. These demands are: (D1) Transitivity: Under conditions D, if an agent believes in A|D more than in B|D, and in B|D more than in C|D, then the belief on A|D should be larger than that on C|D. (D2) If the belief on an assertion can be calculated in more than one way, demanding that the results are the same should avoid manifest inconsistencies. (D3) For all A, the belief in A|A should be the same and for all B mutually exclusive to A, the belief in A|B should be the same. (D4) There must be some function G that permits obtaining the belief about the logical product AB|D in terms of some subset of beliefs that include A|C, A|BC, B|C and B|AC but not necessarily all. (D5) There must be another analogous function F for the logical sum A+B|C. Implementation of these demands leads to probability theory or simple monotonical regraduations. It leads to Bayes theorem, permitting the introducion of prior knowledge and to take into account structural information about the architecture of the cognitive system. Of course this approach is not constrained to cognition, but has founded extended use including machine learning and data analysis in general. More generally, Bayesian Inference can be shown to be a special case of Entropic Inference.

b) "What Machines can learn from Doctors and Doctors from Machines: Lessons from Bayes Nets as Diagnostic Decision Support Systems in Tinnitus"

Peter M. E. Classens* ; Jangholi, Nargess; Ghodrati Toostani, Iman; Ganz Sanchez, Tanit
(* UFABC)

Medical doctors, through training and experience, attain high levels of efficiency and accuracy in diagnosis, in a process of probabilistic reasoning that narrows down a set of potential causes based on a limited amount of observable data. While medical symptoms or test results are individually generally insufficient to isolate the etiological basis of a complaint, in combination they provide sufficient information to identify a cause in a procedure that is not unlike sensor fusion. A normative model for determining hidden causes in a set of probabilistically dependent and interacting variables is provided by the class of Bayes nets, or Bayesian belief networks. This formalism, which combines elements of probability and graph theory, is therefore an interesting reference for comparison with human diagnostic decision

making, not only for the final decision on the etiology of a case, but also in the intermediate steps chosen to reach the diagnostic conclusion.In this talk, virtues and cognitive shortcuts in medical decision making will be reviewed. A short introduction in causal inference using Bayes nets will be given, after which a study on the construction of a diagnostic decision support system for the differential diagnosis of tinnitus, a common disorder producing physical or subjective ringing or buzzing noises, will be presented. The formal analysis of decision under uncertainty as provided by Bayes nets point towards interesting points of convergence and divergence with human medical decision making. As basis for diagnostic support systems, Bayes nets have large potential but a few challenges to solve in implementation, as will be discussed.

c) Learning Representations through Deep Learning

Edson S. Gomi
(University of São Paulo (USP), Polytechnic School, Department of Computer Engineering)

The performance of machine learning algorithms has been highly dependent on a previous choice of abstract features obtained from the raw data. In order to enable the development of machine learning algorithms that identify features automatically, Deep Learning uses several composition and transformation layers to learn an appropriate representation for a given data. Successful representations have been obtained in Deep Learning experiments of recognition and classification tasks using text, speech, and image data. This talk will present the basic concepts and application examples, in order to give an overview of Deep Learning and its relationship with Neural Computation.

d) Brain networks maturation and psychopathology: an interdisciplinary approach

João Ricardo Sato
(UFABC)

In this lecture, we present recent findings in brain imaging and neurodevelopment in humans. The main focus is on the brain networks maturation during late childhood and pre-adolescence. We discuss about the emergence of functional networks and how they can be analyzed using statistical and computational methods. Findings based on developmental curves, graph theory metrics, signal processing and machine learning are presented. Finally, we demonstrate the association between neurodevelopmental disruptions and manifestations of psychopathology.

Round table 6

Computational Intelligence and Cognition

Emilio Del Moral Hernandez (USP/POLI – coordinator)
Francisco Javier Ropero Pelaez (UFABC)
João Henrique Ranhel Ribeiro (UFPE)

a) From Neuron Cells to Cognition: a Review

João Henrique Ranhel Ribeiro
(Federal University of Pernambuco, Department of Electronics and Systems)

Nervous systems give rise to animals' intelligent behavior and can make them cognitive agents. This presentation reviews the intelligence and the cognition concepts. A central topic in cognition is 'learning', meaning the agent's ability to modify its behavior during its lifetime, what is quite different from inborn stereotyped responses. Then, it is briefly discussed the learning types (supervised, unsupervised, reinforced and deep learning) and the biological neural bases underlying such learning mechanisms. I intend to show a new model of artificial spiking neural network that allows us to simulate the main natural mechanisms (neural plasticity and astrocytes). Two main issues is proposed for debate: first, how close can artificial neural networks be from biological networks? Second, to what extend is it important to mimicry natural neural networks? While deep-learning and other machine learning technics have obtained great success in many areas or Artificial Intelligence, we may ask if scientists can create different and more efficient cognitive machines than those based on biological neural mechanisms.

b) Rate-code neurons versus spiking neurons: where and when using each one

Francisco Javier Ropero Pelaez
(Federal University of ABC)

Although spiking-neurons models seems faithfully mimic real neurons' behavior, we believe that in many cases, neurons' spikes are dispensable. The reason is that spikes are, in most neurons, a means for modulating analog voltage-signals at the neuron's soma for allowing a faithful transmission of these signals along neuron's axon. Nowadays, one popular method of signal transmission is Pulse Density Modulation (PDM), which modulates analog signals in exactly the same way neurons modulates soma voltage-signals. The reason for modulating analog signals is avoiding attenuation and interference through a channel. As in artificial models there is no a physical transmission channel, there is neither attenuation nor interference and, therefore, there is no need of modulating processes like PDM or spikes. In most cases, rate-code models are simpler and faster than spiking models. Despite all these reasons, there are sophisticated brain processes in which temporal sequences are important and in which spiking neurons are necessary. Thalamic encoding processes and temporal binding in apical dendrites are examples of these sophisticated processes. The conclusion is that, for an efficient computation of biologically inspired networks, a rationale for where and when using rate-code and spiking neurons should be considered.

c) Diversity of Model Neurons and Implantable Electronic Devices

Emilio Del Moral Hernandez
(Polytechnic School of Engineering, Department of Electronic Systems University of São Paulo)

Spiking Model Neurons and Rate Coding Model Neurons are some of the most important directions in the current scenario of research in Artificial Neural Networks, and application, having produced important systems and devices, which are very relevant for automatic pattern recognition, fusion of heterogeneous multidimensional information, control, support for automatic decision, as well as, more recently, for the area of Brain-Machine-Interfaces and implantable devices for diagnosis and rehabilitation. At the same time, the enormous evolution of electronic systems and microelectronics observed in the recent decades, have allowed scientists and developers to conceive extremely compact systems, based on integrated circuits, signal processing, micro sensors and micro actuators, with huge potential for powerful information processing, sensing and control, conjugated with high adaptability to the environment changes and its variations. This talk addresses some of the important current issues in artificial neural networks in the context of electronic implementation for implantable devices and the potential impacts in terms of the future scenario of human to machine communication, medicine and neuroscience.

Round table 7

Linguagem, comunicação e cognição

André Leclerc (UFC/CNPq)
Leland McCleary (FFLCH/USP)
Evani Viotti (FFLCH/USP)
William Alfred Pickering (CLE/Unicamp)
Walter Teixeira Lima Junior (U.Metodista)

a) Spontaneous linguistic understanding

André Leclerc
(UFC/CNPq)

First, I will delimitate the concept SPONTANEOUS LINGUISTIC UNDERSTANDING, contrasting what it represents with hermeneutic practices, reflexive and inferential in nature, and with the understanding in a language not fully mastered. After that, I will criticise the epistemic view of linguistic understanding. Finally, I will try to develop the idea that linguistic understanding depends upon a more primitive form of understanding that I call the understanding of situations. This is why we understand so easily deviant sentences, ungrammatical or incomplete sentences, nonsenses, malapropisms, etc.

b) Linguistics in search of a semiotics of interaction

Leland McCleary (FFLCH/USP)
Evani Viotti (FFLCH/USP)

Saussure's famous binary options — langue over parole and synchrony over diachrony —laid the intellectual foundation for a linguistics that has been virtually impervious to increasing evidence from sister disciplines (including, but not limited to cognitive science) that language must share with life, and in particular with social life, the quality of being a self-organizing, dynamic complex system. The Chomskyan turn toward a 'cognitive' linguistics, with its option for the study of 'ideal speaker' competence to the exclusion of performance, further isolated linguistics from a view of language as an intrinsic feature of human sociality. Even versions of usage-based cognitive linguistics that have emerged in the wake of the 'embodiment' phase of cognitive science have remained committed to the binary Saussurean sign of 'signifier-signified' (e.g. Langacker, 2008), while at the same time arguing for the dissolution of such traditional distinctions as lexicon vs. grammar and word meaning vs. encyclopedic meaning. Thus, within linguistics there is currently a disconnect between established semiotic theories and those tendencies most inclined to incorporate (and contribute to) advances in the cognitive and social sciences, specifically theorizations of language originating at the interface with sociology, anthropology and psychology on such topics as multimodality and co-speech gesture, distributed agency and cognition, and interactional alignment and sequential organization across multiple time scales. Recently, these threads have been given theoretical coherence within a dynamic, neo-Peircean semiotics, in which semiosis is understood as an ongoing process which emerges in and through every interaction, including, but not limited to, the linguistic (Kockelman, 2005, 2013; Enfield, 2013). We hope to be able to illustrate the advantages of this dynamic, multimodal view of semiosis by analyzing excerpts of face-to-face interaction.

c) Linguistics and self-organization theory

William Alfred Pickering
(CLE/Unicamp)

Within linguistics, there has been a significant growth of interest in the theory of self-organization over the last twenty years. In my presentation at the EBICC 2015 meeting I will present concepts from the theory of self-organization, and indicate several important similarities between self-organizing complex systems and human languages. Through this comparison, I try to show the general plausibility of considering human languages as self-organizing complex systems. The implications of this approach for linguistics will be discussed, and I will argue that self-organization theory can bring unity and coherence to the understanding of various linguistic phenomena.

d) Social Communication, Cognition and Neuroscience

Walter Teixeira Lima Junior
(Metodista)

Social Communication has undergone huge influence of Sociology since its primordia as scientific field. In the last 60 years, the discipline has experimented various phases based on analysis of behavior through mass media artifacts. Media is the unique place to study the mass communication phenomena. With the same focus, psychology and linguistics, more strongly anchored in semiotics, has helped the field of Social Communication advances to understand how language processes are structured from media consumer behavior analysis. However, the behavior as theoretical edifice, behaviorism, was eclipsed in the 1980 and 1990, when neuroscience finally managed to advance beyond the use of the analogies to understanding the communication black-box. Advancing in concept that Language is systematic, and so it can be described in terms of rules and general principles, the neuroscience can help the Social Communication the understand the understanding how language interacts with other cognitive processes. This scientific field has advantage to be tested experimentally, helping to complement the theoretical scope in order to comprehend how the communication transfers information from media to person.

Round table 8

The mind-body problem: reductive and nonreductive physicalisms

Alfredo Pereira Jr. (Unesp/Botucatu)
Jonas Gonçalves Coelho (Unesp/Bauru)
Osvaldo Pessoa Jr. (FFLCH/USP – coordinator)

a) The hydro-ionic wave: a new model of cognitive and affective processing in the brain

Alfredo Pereira Jr.
(Department of Education – Bioscience Institute – Univ Estadual Paulista (UNESP), campus Botucatu, SP.)

Beyond the "Neuron Doctrine" formulated by Ramon y Cajal – proposing that neurons are the structural and functional unit of the mind/brain – our current theoretical framework has been updated to include neuro-glial interactions. In recent years, there is a debate as to how the astroglial network modulates neuronal activity, influencing cognitive, affective and behavioral processes. The hypothesis of modulation by means of gliotransmitter release by astrocytes, activating a synchronous neuronal assembly was not confirmed 'in vivo´. Other transmitters have been proposed for this modulatory function, such as the cholinergic and purinergic ones. Another possibility is the "Hidro-Ionic Wave": a continuous energy exchange mechanism that traverses the neuro-glial arrangement. Inside astrocytes, it has the form of a "calcium wave"; in the extracellular medium, it changes to a potassium current that changes the pattern of organization of the aqueous gel, which interacts with the neuron membrane and modulates the pattern of neuronal activation.

b) The placebo effect according to double sided approach to the mind-body relation

Jonas Gonçalves Coelho.
(School of Architecture, Arts, and Communication – Univ Estadual Paulista (UNESP), *campus* Bauru, SP.)

My aim in the present paper is to interpret the placebo effect according to the "double sided approach" of the mind-body relation. I am therefore accepting the challenge made by the researchers Donald D. Price, Damien G. Finniss & Fabrizio Benedetti in the paper "A comprehensive review of the placebo effect: recent advances and current thought": "Powerful placebo effects reflect mind-brain-body relationships, and there is a need to philosophically resolve explanations of these relationships without resorting to eliminative materialism or forms of dualism that completely divide the mind from the body" (p. 586). The quotation indicates that the authors have a non-reductive physicalist view of the mind-brain-body relation, according to which neither the mind should be eliminated, nor should it be separated from the brain-body. This means that the mind, the body and the relation between the two have a fundamental role in the placebo effect, a thesis that the mentioned neuroscientists intend to prove, transferring to the philosophers the task of solving the mind-brain-body relation. To deal with the problem of the mind-brain-body relation, following the lead of the placebo effect, I will start by presenting some definitions of the placebo effect, attempting to explicate the terms in which one establishes the distinction and relation between mental (psychological) processes and cerebral/bodily (biological) processes. I will then try to show how to interpret the placebo effect

form the two inseparable and irreducible sides of the mind-brain relation, i.e. “mind as brain” and “brain as mind”.

c) Non-identical versions of the mind-body identity thesis

Osvaldo Pessoa Jr.
(Department of Philosophy – FFLCH – University of São Paulo)

The presentation will begin by arguing that the mind-body identity thesis is essential to any reductive physicalist view. But a little reflection indicates that there are at least as many versions of the identity thesis as there are different monist solutions to the mind-body problem. After exploring early defenses of the view, it will be stressed that the identity thesis of U.T. Place (1956) in fact privileges the scientific description of the brain, instead of phenomenal consciousness, and that this version of materialism carries over to Smart (1959). This is clearer in Feyerabend’s (1963) version of identity theory, which eliminates mental concepts altogether. On the other hand, radical idealism also identifies mind and body, but considers that everything is mental. An intermediary version of the identity thesis was presented by Fechner (1860) and Th. Nagel (2002), following Spinoza in proposing a monist view of reality of which mind and matter are two different aspects or perspectives. But returning to reductive physicalism, one may also adopt the identity thesis while privileging the phenomenal subjective quality of consciousness (described as sense data, raw feels or qualia). This results in what might be called “qualitative physicalism” (or “colored-brain thesis”), proposed by Case (1888) and suggested by Boring’s (1933) formulation of the identity thesis, and which will be further explored.

Round table 9

Cognitive Neuroscience of Art: Dialog among Human, Biological and Exact Sciences

Ronald Ranvaud (USP/ICB – coordinator)
Mirella Gualtieri (USP/IP)
Maira Monteiro Fróes (UFRJ)
Patrícia Vanzella (UnB & UFABC)

a) Artistic Experience, Expression and the Brain

Mirella Gualtieri.
(Institute of Psychology - University of São Paulo)

We are now at an interesting time in the exploration of the relationships between neuroscience and art. Let us considerer three major factors on which art is constructed: inspiration, creativity and aesthetics. From a neural point of view, inspiration is a mental experience relying on the integration of subcortical (motivation/reward, emotions) and frontal cortical areas of the brain. As an experience integrated by goal-directed behavior, inspiration can be closely related to creativity, which can come spontaneously or as a result of deliberate action. Deliberate creativity could be summarized, according to Damasio (1994), as emotional evaluation of a set of cognitive processes and its neural substrate initiates with prefrontal cortical activity, whereas the spontaneous creative processes seem to arise from temporal cortex activity. At the core of creativity, the intimate linkage between highly variable cognitive and affective features of the brain often leads to situations where the artist's work reflects a form of knowledge and insight about the world that precede scientific exploration of the same phenomena. For instance, the kinetic art of Tinguely long preceded the discovery of the cortical visual motion area (V5), but the artist already knew that color and shape did not matter when motion is the means of communication. Many artists understood how to manipulate shading to emphasize edge by creating illusory enhancements that the vision science community understands to be Mach Bands, discovered by the physicist Ernst Mach and documented physiologically only many years later. Aesthetic-related brain areas, mainly the anterior insula and prefrontal cortex, are active in response to classical beauty and are also activated when people watch elite, dynamic athletic performance, or manifestations of forces of nature, or even when presented with elegant arguments or theoretical concepts, which may be experienced as examples of loftiness or the sublime. It has been shown that the brain structures activated during experiences of beauty and of the sublime are different. The implications and importance of such neuroscientific findings regarding the arts are both wide-ranging and profound. For example, it is now possible to evaluate, from a neuroscientific perspective, the diversity of the impact of art on different individuals. For that matter, the role of experience upon the brain has also been shown to have an impact on the aesthetic experience. The judgment of consonant or dissonant pairs of tones according to the Pythagoras' ratio rules was remarkably different among musicians and non-musicians, with the level of brain BOLD response being proportional to the magnitude of the Pythagorean ratio in the musically trained but not in the untrained subjects.

b) An Artsci Science

Maira Monteiro Fróes
(Federal University of Rio de Janeiro, Centro de Ciências Matemáticas e Natureza, UFRJ).

Would aesthetical immersion drive cognitive handling in science? This question has been systematically addressed through controlled scientific experimentation in my laboratory. In a partnership with artists, my lab has intentionally developed tools for a non-conventional aesthetical contextualization of scientific material and conjectural objects. In one of the experimental investigative fronts, distinct groups of undergraduate students from the university's schools of fine arts and life sciences (Department of Phonoaudiology) were invited to answer the Aesthesis quest, a Web questionnaire we have specially conceived. Aesthesis was designed to evaluate primary aesthetic, emotional-affective and cognitive aspects of perception developed in response to conventional and non-conventional referential anatomical images. These subjective qualifiers represent foundational aspects of human perception, as aesthetics, emotion, abstraction and analytical thought. Our results confirm our expectation that non-conventional contextualization of the anatomical object, provided by contemporary art treatment, alters aesthetical, emotional and cognitive markers of perceptual assessment. Notably, they favour our more speculative hypothesis that cognitive resources for abstraction and abstract thought itself are positively correlated with the contextualization of the scientific object by contemporary art. Our results also point to involvement of positive emotion and judgments of beauty, suggesting that, together with gains in abstraction, these might represent interrelated, indissociable aspects of a scientific objectivity impregnated by the aesthetical experience.

c) Emotion in Music from a neuroscientific viewpoint

Patrícia Vanzella (University of Brasília and Federal ABC University).

Musical behavior is a primordial and universal human characteristic. Among the most ancient artefacts encountered in archeological excavations are musical instruments, and there is no evidence of some civilization that does not engage in some type of musical activity. It is undeniable that music evokes and modulates emotions, promotes social cohesion and synchronizes both movements and states of mind. Several experimental techniques (EEG, NIRS, galvanic skin respose etc) allow to measure reliably behavioral, cognitive and neurophysiological changes associated with music. From a neuroscientific point of view the challenge is threefold: to identify the varied neural mechanisms whereby music engenders such resposes, to identify which of the physical parameters of the sound wave are important, and to understand how these physical parameters participate in the above neural mechanisms.

d) Cognition, Music, Plastic Arts and Literature

Ronald Ranvaud
(Institute of Biomedical Sciences, University of São Paulo)

Among the most fundamental functions of the nervous system is generating predictions as to what will happen next. This is possible by constantly monitoring the environment and relying on prior experience. Good predictions permit preparing timely and adequate motor responses as circumstances evolve. Generating predictions is an automatic process which runs continuously, even though awareness of its operation is generally lacking. Of course, it is also possible to generate predictions voluntarily, focussing attention and reasoning on the challenge

being faced at any moment, but, thankfully, under normal conditions it is not necessary to exert such effort. Generating predictions has great adaptive value, permitting proactive rather than merely reactive behavior. Generating expectations is also an essential part of cognition, as can be realized considering that the etimology of the word cognition remits to knowledge, or knowing, and further considering what knowing something means. For example, what knowing a person mean? Rather than just having information as what the name of the person is, and their address, telephone number and so on, knowing someone really means having a good idea of what the person will do under different circumstances, i.e. predicting, albeit with some limitations, their behavior. Several theories of Artistic Cognition also are based of the idea of generating expectations. According to this approach, the charm of music would result from the alternations of moments described in musical theory manuals as moments of relaxation (expectations confirmed) and moments of tension (expectations negated). These concepts can also be applied to the plastic arts and literature, and they thus form a solid basis for the neurophysiological study of artistic behaviors.

Round table 10

Some historical and evolutionary perspectives on mind, brain, and cognition

Hamilton Haddad Junior (IB-USP) (coordinator)
Maria Inês Nogueira (ICB-USP)

a) Evolution, niche construction and human cognition

Hamilton Haddad Junior
(Instituto de Biociências, Universidade de São Paulo)

The purpose of this talk is to examine some recent approaches of human mind and cognition beyond the biological processes, pushing also the boundaries of traditional computational approaches arising from the artificial intelligence. The main idea is to analyze theories that reinforce the role of niche construction on human cognition and try to conceive the mind as essentially dependent on an environmental scaffolding process. Many non-human animals modify theirs immediate environment, shaping it to improve fitness; these organisms in part adapt to their niche and partly build their own niche. This process of 'niche construction' (Laland *et al*., 2000) has been postulated as an important factor in evolution. It is suggested that over the evolutionary process of human species, a scaffolding process in the cognitive domain occurred similar to that niche construction. Human ancestors epistemically modified their environments, which were inherited by subsequent generations. The cognitive abilities of these new generations depend on, and were transformed by, these new environmental resources – these resources were built, modified and preserved precisely because they improve cognitive capacities (Sterelny, 2012). This dialectical process, in which agents modify their epistemic environment which retroact over the agents, is assumed to be the cornerstone of evolution and the current mechanisms of the human mind.

b) History of the morphofunctional comphreension of the brain and its relation to cognition

Maria Inês Nogueira
(Laboratory of Neuroscience, Anatomy Department, Institute of Biomedical Sciences, University of São Paulo)

Under this heading are addressed, historically, some concepts, ideas, actions and techniques that influenced our current knowledge on the brain. Which is understood as part of the encephalon, an organized tissue composed by two basic cell types: neurons and glia, but with great variety of form function and distribution. The encephalon is the rostral part of the nervous system present in vertebrates protected by a cartilage or bone box (skull). It is comprised by the brainstem that supports the brain (tele- and diencephalon) and the cerebellum (little brain). However, the focus of this historical approach lies in the human primate, Homo sapiens, however keeping in mind the warning that evolution is not linear, and that the brain did not evolve just by putting new more complex structures over the less ones, and in that man occupies the top of the list. In revisiting the history of science, we seek to understand the importance attributed to the head, brain and heart as to its relevance to sustain life, thinking, feelings, actions and reactions. Where the ancient civilizations of the old and new world found the site of reason and emotions? Is it possible that only the brain is reponsible for them? Which is the substrate to monism, dualism, localizationism, holism. Along the way, there is a search to identify how has the understanding of the organization and brain functions evolved and what

were the competing factors for both: the main searchers, concepts and technologies relevant to the current understanding, but still incomplete, of the brain and the nervous system. How did we get to neuroscience (neural plasticity, neural communication, somatic markers) and what is its relationship to cognition. Are Artificial Inteligence models a true representation of the brain and mind relation, as some use to say like hard- and software?

Round table 11

Cognition in Peirce's Semiotic

Vinicius Romanini (USP/ECA – coordinator)
Ivo A. Ibri (PUC/SP)
João Queiroz (UFJF)

a) Everything Speaks – The Pragmatic Signs of Semiotics

Ivo A. Ibri
(Center for Pragmatism Studies – PUC/SP; Charles S. Peirce Society)

Peirce is well known as the father of Semiotics and classical Pragmatism. Nevertheless, the studies that deepened the intimate relationship between both theories still are few, which I suppose to be very essential to a fairer consideration of the systemic constitution of Peircean philosophy. One way to do such a task would be a serious study of the ontological realism as adopted by Peirce, one main axis of such system. However, such a way has been misunderstood, or even disregarded on its importance, by many scholars and, as a consequence, it is not infrequent to see nominalistic interpretations of those theories impeding the realistic connection between them. Another visible way to establish the relationship between Semiotics and classical Pragmatism is to consider what I have called categorial symmetry, a concept built throughout the passage from Peirce's phenomenology to his ontology. Such symmetry will provide an extension of the notion of language to Nature and, by doing so, enable us to consider that everything speaks. In other words, pragmatic signs are meaningful as a true saying of the natural and human inner worlds, allowing an ample concept of interpretant signs through the observation of the conduct of every being in the universe.

b) Distributed creativity in Peirce's cognitive semiotics

João Queiroz
(Iconicity Research Group; Instituto de Artes e Design/UFJF)

Charles S. Peirce can be considered an important precursor of situated mind and distributed cognition thesis. But differently from the anti-cartesianism defended by some embodied-situated cognitive scientists, which is predominantly anti-representationalist, for Peirce, mind is semiosis (sign-action) in a dialogical -- hence communicational -- materially embodied form, and cognition is the development of available semiotic artifacts. It takes the form of development of artifacts, such as writing tools, instruments of observation, notational systems, languages, and so forth. My aim here is to explore some connections between Peirce's semiotic theory of mind and the conception of distributed creativity through the notions of iconicity and semiotic niche construction, taking advantage of examples in dance and poetry improvisation. According to this approach, creativity is a property of cognitive artifact manipulation and niche construction. More specifically, creativity is distributed as opportunities for evolution in semiotic niches.

c) The Solenoid of Semiosis as a general model for cognition

Vinicius Romanini
(PPGCOM, University of São Paulo, USP)

Early in his studies, Peirce considers cognition as a particular case of representation in conscious minds and, following his ubiquitous triadic divisions in firstness, secondness and thirdness, defines its basic elements as feelings, efforts and notions. While Peirce maintains this basic structure throughout his career, his late theory of cognition broadens as he becomes an extreme realist. The sign is then defined as a "cognizable" that allows for information not only in actual but also in possible minds. Cognition is not a psychological faculty of individual minds, Peirce claims, but a logical process than can be explained by the general laws of mind that govern the development of life and even the grow of complexity in physical systems. We will present here a model, called the Solenoid of Semiosis, that analyses the action of sings in its minute logical elements and relations. I will also apply it to an example of cognition often quoted by Peirce: the information conveyed by a weathercock. Our hypothesis is that the Solenoid of Semiosis can function as a general model for cognition.

Round table 12

Logic, consequence operators, and information

Hércules de Araújo Feitosa (UNESP - FC – Bauru)
Itala M. Loffredo D'Ottaviano (CLE-Unicamp) (coordinator)
Marcos Antonio Alves (Unesp-Marília)

a) Consequence operators and consequence relations

Hércules de Araújo Feitosa
(UNESP - FC – Bauru)

At the beginning of 20th century several different logics appeared from the logic until considered the Logic. From that time we have named the Logic introduced by Greeks, with particular contribution of Aristotle, so a construction from classical world, by Classical Logic, and the other logics distinct from Classical Logic we have named non-classical logics. In 1930, Alfred Tarski tried to explicit the common aspects of all these logics. For that, he defended that the fundamental aspect of any logic is on its deductive context. Thus, the central notion is the deduction, derivation or consequence. Tarski defined the consequence operator of Tarski, a function that puts emphasis on the fundamental aspect of consequence. In a complementary way, many logic textbooks usually consider the consequence as a relation that associates or links a set of information with conclusive information. Relation is a more general concept than a function. This notion puts the inference in evidence, from which we obtain a conclusion from a collection of premises. We observe several different definitions of consequence relation in the logical environment. In this paper, we present some of these formulations and collate these definitions. Our contribution to these analyses is to show that even though there is equivalence between some of them, a given principle is stronger than another one that occurs in another definition. This way, we observe the independence of some principles and try to expose with clarity and simplicity these basic notions of consequence. We do that in the context of universal logic, without using artificial languages, but only using set theoretical tools. In this case, we do not use the operators of negations, conjunction, disjunction and other logical operators. We only work with operators and relations that preserve the essential characteristics of a Tarski logic. Nowadays, many new logics are proposed and even the general aspects of these operators and relations are not enough to involve them. These more general notions must be investigated in the context of universal logics in future researches.

b) A quantitative-informational approach to logical consequence

Itala M. Loffredo D'Ottaviano
(Unicamp, Philosophy Department, Centre for Logic, Epistemology and the History of Science – CLE, University of Campinas, Campinas, Brazil)

In this work, we propose a definition of logical consequence based on the relation between the quantity of information present in a particular set of formulae and a particular formula. As a starting point, we use Shannon's quantitative notion of information, founded on the concepts of logarithmic function and probability value. We first consider some of the basic elements of an axiomatic probability theory, and then construct a probabilistic semantics for languages of classical propositional logic. We define the quantity of information for the formulae of these languages and introduce the concept of informational logical consequence,

identifying some important results, among them: certain arguments that have traditionally been considered valid, such as *modus ponens*, are not valid from the informational perspective; the logic underlying informational logical consequence is not classical, and is at the least paraconsistent *sensu lato*; informational logical consequence is not a Tarskian logical consequence.

c) Implication and information: a quantitative-informational analysis to material implication

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We show that the usual material implication does not capture the notion of information as developed in Mathematical Theory of Communication by thinkers like Shannon. Initially, we define this quantitative notion of information, and then we introduce a probabilistic semantics for the language of classical propositional logic. After that, we define the probabilistic and informational values of formulae of such language, emphasizing the implication. We present some examples where the informational value of usual material implication does not capture the quantitative notion of information. Finally, we introduce a definition of probabilistic implication, whose definition of informational value is suitable for the quantitative notion of information.