Computational Cognition

Interfacing with the Machine for Improvement of the Mind

Carla Verônica Machado Marques, Carlo Emmanoel Tolla de Oliveira, Claudia Lage Rebello da Motta and Cibele Ribeiro da Cunha Oliveira
Computer Science Department at the Mathematics Institute
Federal University of Rio de Janeiro
Rio de Janeiro, Brazil
{carlaveronica, carlo, claudiam, cibele}@nce.ufrj.br

***Abstract*—Computational cognition is a proposed field of study where computers learn from the brain how to step up natural intelligence. The process begins when subtle traces of internal human thinking leak though involuntary reflexes. Those traces are tracked and mapped to a mental model capable of reconstructing the internal mind narrative. This narrative composed in an alien brain exclusive language can be analyzed and marked for well constructiveness. Language flaws can then guide the study to devise computational cognitive prosthetics to help the achievement of mental thinking fluency.**

Keywords—cognition; natural intelligence; mental modelling; cognitive prosthetics; automata; hci;

I. Introduction

The abundance of human related date is bringing computers even closer to unveil the complexities of the mind. Cognitive computing is taking advantage of this plenty to learn from humans how to make decisions. In the Augmented Cognition field, neuroscientific records of brain activity are helping to trace macro cognition states to monitor and enhance human performance in several tasks. However, the microgenetic states of cognition are the the hallmark of deep human understanding and reasoning. Due to the heavy parallel operation of the brain, the details of such operations lie blurred by millions of incongruent signaling of the several simultaneous attempts by the competing units[1]. How to pick the solely signals of the small bunch of neurons winners of the reasoning rally? The fact is that the forerunner bunch will command the final reaction expressed on motricity signals sent to comply with the given decision. Tracking the idiosyncrasies of this response is the lead to read the microgenetic states that produced it. The paleopatic microgenetic resonance or Marques Resonance is described in this work as the path to investigate the deep thinking machine installed in the natural human intelligence. The investigated human machine is in fact a talking automata. The several states recognized transitions follow through a sequence that reveals a proprietary language, only spoke inside the brain. This language, apart from some exquisite words, is spoken alike in several distinct individuals.

II. Man-Machine Binomial

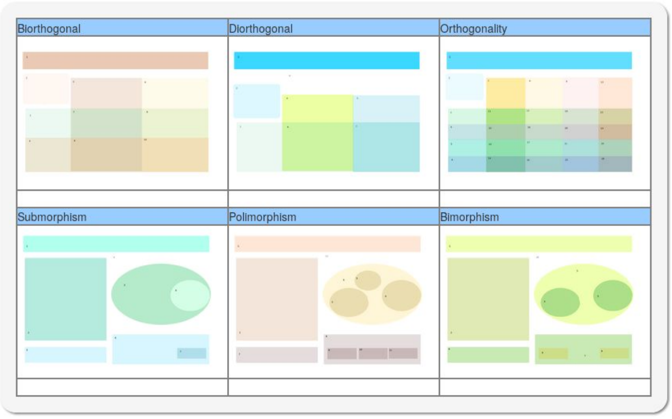
A. A Challenging Barrier to the Interchange of Communication Between Brain and Computational Machines.

The complexity and unobservability of mental whatabouts poses a challenge for research activities. The most significant cognitive-linguistic processes are not directly observable by behavioral analysis nor by the application of psychometric strategies. In addition, there are the technological investigation of electroencephalogram and magnetic resonance imaging but these only reach brain functioning with high energy potential[2].

Searching for a path in which the machine enables a direct observation of the learning processes guided us to investigate possibilities of an immediate communication between mind and machine. The survey indicated Computer Science as the field that offers the main technological possibilities to capture refined information of low energy potential characteristic of complex cognitive-linguistic processing.

With regard to refined information, it is possible to elucidate it as mental models that provide gaps to be filled by items in the language of logical-grammatical thinking. Commanding the interaction between artificial and natural mental models, there is a metamodel. The composition of this metamodel is made by dynamic systems of templates that group and regroup in a componential way. Templates are associated in accordance with the recruitment made by logical-grammatical thinking to take a cognitive leap.

TABLE 1. MORPHOLOGICAL TEMPLATES



B. The Brain Machine Symbiosis and Concurrence to Enhance Mutual Cognition.

Computational cognition is a way of studying the machine as a cybernetic instrument. This instrument should allow the exponential expansion of the cognitive-linguistic competences through the brain-mind binomial. In this study, we are referring to the artificial intelligence given to the machine in order to elicit patterns of high complexity in thinking. This effect is achieved in situations of intelligent learning, that is, during the creative and innovative elaboration and solution of problem situations involving content-processes. That means that there are several epistemic elements articulated in the chain of cognitive and metacognitive states procedures. In this system, the machine is in the role of being an interface equipped with artificial intelligence. Its function is to provide the user with a virtual environment that facilitates such problem situations, thus being a catalyst for cognitive-linguistic skills.

C. Human Motricity an Interspector of Reflexive Actions

According to Lakoff [3], ninety five percent of mental processing is unconscious. Following this logic, it goes without saying that the study of the unconscious is the place where we will find most of the answers to the questions about how does the functioning of the brain-mind binomial works. Direct observation of objective behavior does not reveal much about the unconscious, but when we add the machine as a cybernetic instrument, we expand the depth of information. It opens a window of possibilities for creating cognitive capture by means of computational tools that have high-accuracy through affordance to the human-machine interface in conjunction with the nature of the task being performed by the user.

Also, human motor fine skills are the crucial point of understanding in which refined computational instruments can introspect the reflective action couplings to infer the original mental processes in the drive. Otherwise, it is through human motor fine skills that the computer is able to capture the actions that represent the mental threads. This capture is feasible from the process of building intelligent systems responsible for the elaboration of mental function markers that record the variations of unconscious reflexes.

D. Mental Coalescing Process: The Apical Achievement of the Human Motricity .

The brain is a highly parallel machine, where tasks are assigned to various groups of mental processing units. Each level of abstraction is built on new layers of brain circuits, recruiting new neurons to form more complex networks. Assembling and traversing such networks is an expensive task, impacting on various delays in mental processing. This, in turn, involves a cascade of transitions that flow from these various brain arrays. Traits of these transitions and delays run through the entire system, until they are sent to the motor channels and end up translating into muscular contractions.

When captured, this jitter of movement exhibits seemingly random behavior, explainable by the various differences in the paths taken by the individual as they traverse the processing units of the brain. Much less than random, these fluctuations can be traced back to the type of unit that generated it, allowing you to mark at once the unit responsible for each action. This is from now on, referred to as Marques Resonance [4], where the internal constructs of the brain can be identified by their characteristic waveform appearance. This phenomenon implies a link between subtle variations of motor response to the mental execution of distinctive tasks.

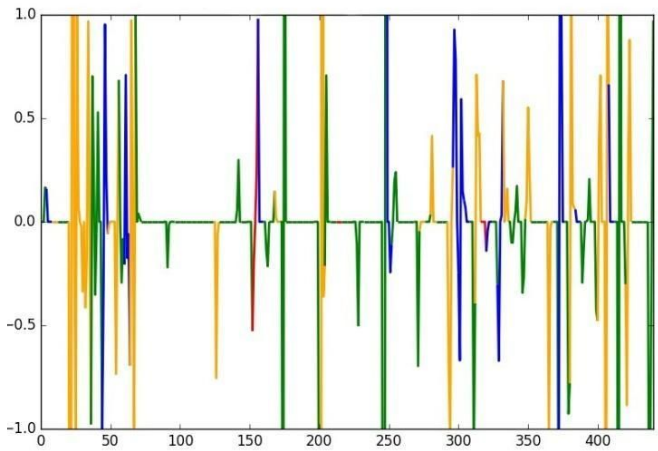


Fig. 1. Response Jitter Marked by Marques Resonance

In the proposed engineering model, the variations are due to the transition to eight distinct microgenetic states. The statistical behavior of the collected states is consistent with the proposed model of stepped complexity, proving the useful model for abbreviated cognitive analyzes.

III. Cognitive Prostheses

E. Mental Process Tracker

The starting point for computational cognition is an adequate cognitive prosthetic apparatus, trained to follow the traces of the mental process. The intelligent game [5] is the propitious instrument to realize the communication of the cognitive language for the computational machine. From the computer game it is possible to access and intervene in the human mental machine. The scope of unconscious processes ensures that the exchange of information between computer and human cognition occurs.

The game-based software provides an interface that connects you directly to human cognitive viso-motor integration. On the basis of this interface, it is possible to collect information through the data mining derived from the application of the game.

The design of an intelligent game requires a scientific process that involves several steps to promote the propagation of reflexive motor action in specific programmable algorithms. To perform this task, it is necessary to construct a dimensional model with markers that will serve as the basis for the development of specific data collection to probe the cognitive space.

Tracking the mental process involved in cognition, requires a machine that is able to record the mode of knowledge acquisition while marking the level of understanding. For this, it is presumed that there is a cognitive machine, more precisely an automaton, through which the process of understanding a narrative of events happens. Through this automaton there is an incessant intercommunication of languages covered with the commitment of logical-systematic reasoning between man and machine[6]. This automaton is endowed with metacognitive, adaptive and evolutionary intelligence.

F. Cognitive Learning Internal Structures

The intelligent game under discussion was designed and calibrated in three dimensions of development to collect the information and to elucidate particularities of the automata language. EICA is a neurobiological computing apparatus that attributes to any individual the cognitive process characteristic of the human species [7]. If the purpose of computational cognition is the construction of a cognitive prosthesis, this machine is the resource to obtain advances of high level abstraction, reaching, thus, the human cognitive excellence.

When analyzing the data obtained from this apparatus, a common pattern emerges to all (universal of cognition) and each individual (cognitive signatures). These supposedly chaotic and disaggregated patterns when placed under Marques Resonance, are shown in an ordered sequences of minimum segments combinations, composing differentiated types and ,also, of seriations (phonemes, morphemes and lexicon). Therefore, the brain machine has a language in which occurs an occult dialogue between the brain structures. Retraces of such resonant apparatus reveals mental process as a stream of alien words connected into phrases permeating any intelective interaction. After Marques Resonance, it was identified that the intelligent mind, when executing logical-grammatical operations to give cognitive leaps towards learning, activates a proper language of codification and decoding that is independent from the natural languages we are acquainted with. It is a machine language, in this biological case, composed of phonemes, morphemes and lexical items.

IV. Internal Language

The brain is probably the most complex system known [8]. Despite this, we were able to capture in our experiment some of its traces , using the analysis of pattern repetition and minimum unit segmentation. In such analysis, it was feasible to identify these arrangements alone or combined in three different levels: phoneme, morpheme and lexicon. This triad develops a universal cognitive-linguistic law of the binomial brain-mind. The operation previously mentioned forms a self-organized and hierarchical system[9].

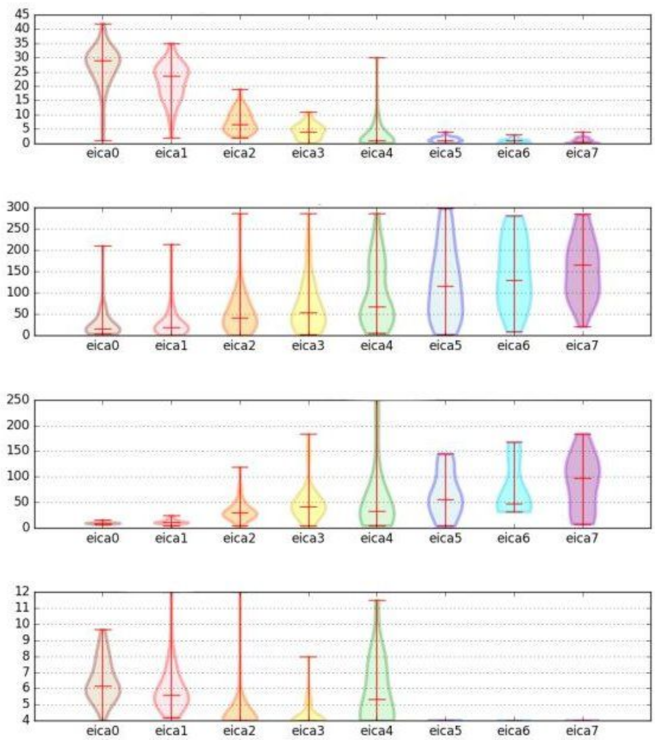


Fig. 2. Hierarchical Language Consistency Over Population

The internal language, apart from minor slangs, seems to be commonly spoken by distinct brains of unrelated individuals. Based on the study carried out on how the brain learns it was possible to notice a machine language consistency over the population.

G. Correlations: Recognizable Aspects of Intelective Performance.

The language of the mind is an internal representation of reflective thoughts referring to a cognitive stream of actions. Each term must correspond to a cognitive operation or compose a sentence describing it.

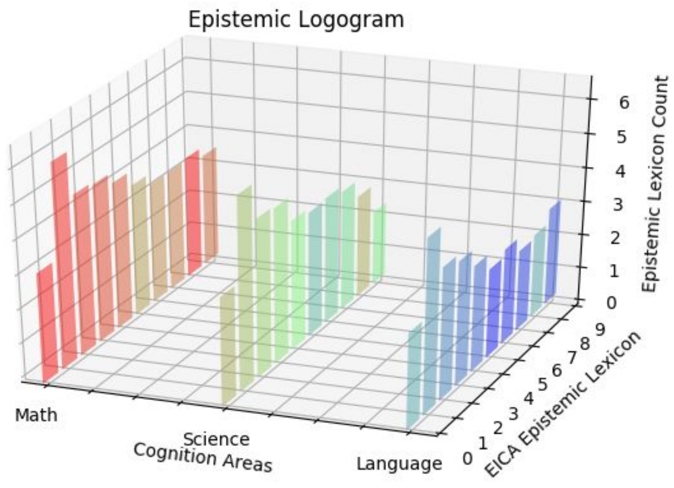


Fig. 3. Distribution of the "Nine Lexicon" over Cognition Areas

The capturing instrument allows for intellective operations in the cognitive areas, namely mathematics, science and language. The resulting plot presents the count of the nine most expressive words in the mind lexicon occurring when each cognitive area is active.

Although the three profiles are rather similar, some subtle nuances are noticeable and can indicate a trending usage of the term. Terms zero to four seem equally distributed on the three areas, representing probably syntactic helpers not attached to any particular area of process-contents. Terms five, six and seven are telltale of each cognitive area considering their relative counts in the set. Term eigh seems to have a decrease of relative importance going from maths to language. Term nine is highly significant for language and least for science.

Although the current instrument being still coarse to pinpoint for shure the meaning of each mental term, it shows some evidence that further enhancements can lead to better results. The different aspects of the term groups implies that there is a grammar behind the mental language and more analysis on current and further data can yield some sketches on the grammar structure of this language.

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