Editorial

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A premonitory thinker said that "I believe that at the end of the century (20th century) the use of words and general educated opinion will have altered so much that one will be able to speak of thinking machines without expecting to be contradicted" (Alan Turing, in "Computing machines and intelligence", *Mind,* 59:433-460, 1950). Is this true now? Not yet, but it will.

In Artificial Intelligence, many of the problems may be considered as A.I.-complete, i.e. in order to solve one determined problem, you must previously solve them all, e.g. machine translation.

So far, there is no established unifying theory, or paradigm for Artificial Intelligence research. And many questions still remain unanswered, such as: Can intelligent behavior be described using simple principles, such as Logics? Should artificial intelligence simulate natural intelligence? And so on.

Some of the more useful tools in Search and Optimization, in Artificial Intelligence, will be Reasoning; Learning Search, or Robotics, or Planning Algorithms; Evolutionary Computation; Heuristics… And many different forms of Logic, such as Fuzzy Logic, modulating the degrees, admitting the construction of Fuzzy Systems (L. A. Zadeh, "Fuzzy Sets", *Information and Control,* 8:338-353, 1965, was its seminal paper). But there are, also, many other Logics, such as Default Logic, Non-Monotonic Logic, Modal Logics, and so on. Furthermore, Judea Pearl proposed the use of probabilistic methods for uncertain reasoning, by introducing Bayesian Networks, also called Belief Networks. They solve problems of learning, reasoning, perception and planning. Its derivation from Economics, adding the von Neumann and Morgenstern concept of "utility", gives place to new tools, such as the Markov decision processes or Game Theory.

The simplest Artificial Intelligence applications can be of two types, Classifiers and Controllers. From among the Classifiers, we may mention the Neural Networks, Decision Trees, Gaussian mixture models. There is no classifier that works best on all the problems (No-Free Lunch Theorem).

Artificial Intelligence has many successful applications, as in Law, Medical Diagnosis, Robot Control, etc. But by also claiming to be able to recreate the capabilities of the human mind, it remains as a challenge not only for Philosophy, but for almost all the modern sciences, with many open problems as, for instance: Can the brain be simulated? This is the Artificial Brain Argument, by Moravec, Kurzweil, and others. According to these authors, it is technologically feasible to copy the brain directly into hardware and software, and such a simulation will be essentially identical to the original. Indeed a very disputable and interesting open question, at least so far.

Neuroscience studies the nervous system. In the past, it was considered a branch of Biology, but it is currently an interdisciplinary science, involving Computer Science, Physics, Medicine, and other disciplines. Recent advances have been aided by the use of computational modeling of Neural Networks.

There are many unsolved problems in Neuroscience, many of them closely interrelated with theoretical and practical advances in Computer Sciences, as for instance

- *Perception:* How does the brain transfer sensory information into percepts? What are the rules by which perception is organized? How are the senses integrated?
- *Learning and Memory:* What is the difference between implicit and explicit memories? Where do our memories get stored, and how are they retrieved again?
- *Language:* What is the basis of semantic meaning? How is it implemented neurally?
- *Diseases:* What are the causes (neural bases) of mental diseases, such as addiction, Parkinson´s disease, Alzheimer´s disease, ... Also: Is it possible to recover loss of sensory or motor function?

These problems are described in the interesting book *"23 Problems in Systems Neuroscience",* by van Hemmen and Sejnovski (OUP, 2006), with a title that recalls the famous collection of 23 problems proposed by the great mathematician David Hilbert, in Paris 1900, during the Second International Conference of Mathematicians *(ICM).* He said that "as long as a branch of science offers an abundance of problems, so long is it alive; a lack of problems foreshadows extinction or the cessation of independent development". And in its intervention he also mentions an old French mathematician: "a mathematical theory is not to be considered complete until you have made it so clear that you can explain it to the first man whom you meet on the street". The same text is valid if we replace "mathematical theory" by "systems neuroscience", or "Artificial Intelligence". In fact, AI is a relatively young and very clever child of Mathematics. These considerations give us the underlying purpose for this new, enthusiastic, and very promising publication.