The thinking machine and the educational thought
La macchina pensante e il pensiero educativo

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ABSTRACT
In this paper we will present the relationship that has always occurred between people and technology, "the thinking machine". Such relationship has become so interlaced in our technologically advanced cultures, that technology is itself considered as "the destiny of our time". It is for this reason that in this paper we will try to consider some theories concerning the construction of "intelligent machines", that is, referring to the typical peculiarities of the human thought.
This field's theoretical starting point is strictly physical. The possibility to artificially reproduce intelligence is related to the study of the material of the cognitive processes. The "revolution" that this prospective of study brings in all fields of knowledge is connected to the need to initiate, master and to develop the knowledge of the people-system as an indispensible precondition to whatever realization of the system-machine.
On the one hand, we will analyze this idea from the point of view of information processing, defined as Artificial Intelligence, while from the other side we will analyze the cognitive processes of the people in order to obtain from the machine his/her own intelligent behaviors as well as enquire and study the cognitive processes of the people so that we can artificially identify "the internal artificial architecture" by examining the effects of the cognitive development provoked by the contact with the new technologies.

In questo articolo presenteremo il rapporto che da sempre si è verificato tra le persone e la tecnologia, "la macchina pensante". Tale rapporto è diventato così intrecciato nelle nostre culture tecnologicamente avanzate, che la tecnologia è di per sé considerata come "il destino del nostro tempo". È per questo motivo che in questo contributo si cercherà di considerare alcune teorie relative alla costruzione di "macchine intelligenti", facendo riferimento alle peculiarità tipiche del pensiero umano.
Il punto di partenza teorico di questo campo è strettamente fisico. La possibilità di riprodurre artificialmente intelligenza è legata allo studio del materiale dei processi cognitivi. La "rivoluzione" che questo studio prospettico introduce in tutti i campi della conoscenza è collegata alla necessità di avviare, master e sviluppare la conoscenza del sistema-persona come condizione indispensabile per qualunque realizzazione del sistema-macchina.
Da un lato, è necessario analizzare quest'idea dal punto di vista dell'elaborazione delle informazioni, definito come intelligenza artificiale, mentre, dall'altro lato, vanno analizzati i processi cognitivi delle persone, al fine di ottenere dalla macchina comportamenti intelligenti; è pertanto necessario informarsi e studiare i processi cognitivi delle persone in modo da poter identificare artificialmente "l'architettura artificiale interna" esaminando gli effetti dello sviluppo cognitivo provocato dal contatto con le nuove tecnologie.

KEYWORDS
Artificial intelligence, Cognitive processes, People, Technology, Machine.
Intelligenza artificiale, Processi cognitivi, Persone, Tecnologia, Macchina.

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Introduction

In the summer of 1956 at the Dartmouth College of Hanover in the United States, took place the meeting of a group of mathematicians and logicians who proposed to create programs capable of instructing computers to manipulate the formal languages of logic, thus simulating the fundamental functions of human intelligence and human behavior. These young scientists – including John McCarthy, Marvin Minsky, Herbert Simon and Allen Newell – defined the prospects of a new discipline, called Artificial Intelligence by McCarthy himself. In a few years it became the landmark in the general field of studies on human-machine relationships (Negrotti, 1990). At the conference, it was shown how machines can perform tasks whose solution is considered a sign of intelligence, such as playing chess or proving theorems; in the same year another conference was held in Boston, in which various scholars of different disciplines agreed to the proposal of a model of the mind based on the postulation of internal processes that elaborate symbols or information: this is the birth of "cognitive psychology", which lies at the basis of modern studies on artificial intelligence. In particular, Human Information Processing (HIP) is the version of cognitivism that focuses on the mind-computer analogy. Within this paradigm, the mind is conceived as an entity that filters, selects, adjusts and transforms the data that come from the outside and are processed through the operations of a computation (Bettelli, 2002). The first models of mental functioning in this area that were suggested in the Sixties were characterized by a "serial" elaboration of information information, characterized by drafting process, stages of selection and the final location or output. Although having the merit of being very simple, such models display a very limited capacity for the processing of information. Another area of research that is critical to a comprehensive analysis of artificial intelligence is modern connectionism: it argues that, in order to attain intelligent behavior, machine should reproduce – or, at least, simulate – the functioning of brain at cellular level. Since brain consists of a number of neurons that varies between 10 and 100 billion, and each of them is connected to a variable number between 10 and 10,000 other neurons through synapses, according to connectionists it is necessary to computationally reconstruct the dense network of connections that link the neuronal cells in order to be able to create a truly thinking machine. Nowadays computers transistors, which were created only thirty years ago, are developing at a frightening rate. Given this evolution, it is estimated that by 2020 we will be able to build a computer capable of exceeding the threshold of a million *mips* (million instructions per second) and then compete in complexity with a human brain. New computers will be built with massively parallel processors, capable of emulating the connections of a biological brain, in addition to software that will be programmed as an "expert system".

1. Thinking machine: from cybernetics to artificial consciousness

The traditional analogy between man and machine thanks to the evolution of the logical-mathematical sciences of the late Nineteenth century and the technological advances of the early decades of the Twentieth century, has obtained the extraordinary opportunity to engage scholars of different subject fields in one of the biggest rushes ever known. In the Eighties, the metaphor of mind as a computer (according to which the mind is a software and the brain is its hardware) seems to lack much of the appeal acquired in previous decades. According to the

advocates of a strong conception of AI, mind is just a computer program, but their opinion cannot withstand the objections of those who claim that mind is something more than the manipulation of formal symbols (Bailey, 1998). When we think, the words that cross our minds are not simply non-interpreted formal symbols: words have meaning, semantics. The sheer formal symbol of a computer program does not guarantee the presence of semantic content that is located in real minds. The fact that human cognitive activities can be reharsed by a "thinking machine" and that the "riddle of the human mind" can be best understood through the study of computer's mechanisms and processes.

For this reason one question arises: can a machine ever become self-aware?

Computers are improving at an amazing rate, operating at ever faster processing speeds and with larger memories. Software is becoming more and more complex and able to handle a vast array of tasks. But all said and done the final outcome is still just a machine performing a prearranged task and it allegedly does not come up with new ideas of its own or do any thinking.

Accordingly, in 1950, Alan Turing – "the father of artificial intelligence" – posed a similar problem and, in order to determine whether a machine can be considered intelligent as humans, proposed a famous test, known as the Turing test. The test is conceived as follows: an examiner is faced with two workstations, one connected to a computer and the other connected with a human (Copeland, 2004; Petzold, 2008); the examiner then asks questions and observes the responses on the corresponding terminal. If, after a reasonable time, the examiner is unable to determine who is the human being, then we say that the machine has passed the Turing test. Currently, no computer is capable of passing the Turing test, unless we restrict the interaction to a very specific sector, such as chess. The problem of establishing the existence of an intelligent being provided with consciousness and self-awareness is yet more complex. In fact, if intelligence is the expression of an external behavior that can be measured by specific tests, self-consciousness is the expression of an internal state of the brain that cannot be measured.

2. The prospects for the future

The debate on the credibility of the brain-computer analogy highlights that knowledge about the characteristics of human thought results from an investigation of the relationship between mind and its physical counterpart – the brain (Frabboni, Pinto Minerva, 2009). Indeed this is an interesting conceptual leap, moving from a science like physics that describes the events in closed systems, and joining together with cyber security, which describes them in the context of open systems: information circulates and is enriched. In his book entitled *Cognitive Psychology*, Neisser Urlic (1967) explains the existence of a trand which in fact was already already very popular (Neisser, 1967). Cognitivism was defined as a line of research of the convergence of theoretical and experimental investigations carried out in disciplines as diverse as experimental psychology, information theory and cybernetics, linguistics, and neuroscience. Almost all researchers in the Sixties and Seventies whose investigations bore on cognitive processes such as information processing unit welcomed the the mind-computer analogy and, because of that, little attention was paid to the influence of social, historical and cultural cognitive development. In fact, in the second half of the Seventies, all the principles of cognitive psychology were subjected to a critical review which emphasized, inter alia, the need to study human mind under natural conditions,

and not in the laboratory. In this framework, a highly original attempt to address issues concerning the relationships between mind/brain/computer is the so-called "new cybernetics", a research program undertaken to further investigate the biological intelligence through computer simulations of experience-related brain processes. Once abandoned as a model for studies of intelligent behavior, new cybernetic's connectionism changed radically in its perspective (Varela, 1997), so that cybernetics was revived in the Eighties after IT science acknowledged that its models – particularly the MT – were unable to progress beyond a certain point. Connectionists did note that MT was too distant from the "way" in which the brain works. Brain performs analog operations and processes in parallel, whereas computer does not work sequentially and performs analog operations. However, connectionism is not concerned with the functional architecture of machines as manipulators of symbols, because they are primarily concerned with the difficult task of reproducing intelligence's alleged "neural networks" that mimicry natural processes of the brain. This is possible thanks to the connection of different processors, highly interconnected and which hosts programs aimed to improve positive connections right at the expense of the wrong ones, so as to achieve complex cognitive performance.

Conclusions

To conclude, we can say that it is possible to define human mind and determine what characterizes intelligence, although there is still an ongoing debate, both philosophical and scientific, about which mechanisms lead to the construction of thoughts, memories and, thus, personal identity.

Networks' increased ability to learn from experience and filter the noise of complex interactions with living beings make the comparison of computers and human mind very plausible. Philosophically speaking, the problem of connectionism is that of not being able to constitute isomorphic relations as long as the passage from neural functioning (connections) to higher mental processes is concerned (Neisser, 1981). Instead, classical symbolic processors (MT) do the opposite because they explain higher mental processes but fail to establish functional isomorphism at the level of brain's neurons. Human cognitive system, thus, is conceived as a system characterized by a huge number of neurons that evolve; its evolution is based of dynamic, complex and non-linear interactions, and it is strongly affected by experiences that determine one subject's learning when she interacts with her environment.

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