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Artificial Intelligence: The Myth of Information Science

The expression "ethical threats ensuing from the development of information science" calls for explanation on account of its ambivalence. We may speak of a threat from a field of scientific research, a type of technology, or the social application of the products of science and technology when there are unwanted, detrimental, unexpected effects (real or perceived as real), as judged by their consequences, caused by the phenomenon or pursuit. The history of civilisation and technology shows that the consequences of scientific discoveries and technological inventions are to an equal extent good and bad; it is only from a perspective of time or after a long spell of usage that they may be assessed and judged. A telling example are the disparate assessments of atomic physics and nuclear technology, which are still being hotly debated from the point of view of the technological and civilisational (ethical) threats they bring.

It is a similar story with information science (computer science), which is defined as the sum total of the technological, automated operations (performed by digital electronic machines) for the collection, processing, and communication of encoded information which, being a carrier of various items of information and knowledge, exerts an influence on the social aspects of the economy, science, and politics. We may speak of the potential threats from information science in relation to its social impact, since information itself, evaluated from the point of view of information theory, has neither good nor bad effects. Only the indirect effects of information may be considered here, in view of its nature and role in programming and steering, not as an executive agency. A formulation of the problem on the level of the ethical threats from information science must assume all the more emphatically that what will be examined will be the effects of information science.

The social reception of information science: birth of the myth. A scrutiny of the social and individual impact of information science in the sphere of attitudes, expectations, and duties may (or perhaps ought to) describe these matters not only in terms of ethics, but also anthropology. Essentially, for a social or technological

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phenomenon to be individually or collectively perceived as a threat (or ascribed any other axiological sign) it must first become an authentic part of human experience, it must have a genuine presence in the thinking and operations both of individuals and of groups; it must be exteriorised in intellectual products. Only once this process of actual, material impact by socio-technological products on human thoughts and acts has been accomplished can the phenomenon be assimilated as an intentional, internalised experience. The stage of real impact is followed by the reaction stage, though the feelings evoked may be misguided, inadequate, or even illusory.

With this in mind, we should be examining the social and moral issues of information science from the aspect of its real impact on the awareness of its creators and users, and investigating the changing forms and deformations of its social reception. In this sense it is worthwhile speaking of the myth set up on the boundary between information science and its mass reception. The myth-generating situation arises in a time when and space where the theoretical and practical power of information science meets with a special social interest and expectation.

In this case the phenomenon which should be identified as a myth is a suggestive, simple and coherent, far-reaching image of Man and reality constructed on the basis of information terminology and referring to the laws of the formal sciences (information and communication theory, cybernetics, computer science), on their basis explaining and anticipating the way both Man and digital machines work. The form and content of this myth are built up from numerous theories of artificial intelligence – one of the most dynamically developing branches of information science. Apart from their engineering and programming aspects, theories of artificial intelligence entail a series of psychological and philosophical concepts in which mathematical models and terminology serve to present an image of the fundamental categories of anthropology, such as mind, body, thinking, action. The acuity, pictorial intensity, and power of impact this myth commands are significant enough for it to deserve, indeed require, an attempt at its reconstruction and critical review. Essentially, the myth carries in its impact a certain threat to the self-awareness of Man in the Age of the Computer Revolution: a threat which concerns Man's sense of identity and self-reflection.

An old myth in new robes. Theories of artificial intelligence expressed in the terminology of information theory, cybernetics, and computer science are not that new; in reality they are yet another version of the old myth of Machine Man, the roots of which go back to the 17^{th} century. Since the dawn of the modern age there has been a whole series of comparisons in philosophy and science of Man (his body and his mind) with a variety of mechanical devices, such as clocks, musical boxes, hydraulic appliances (at the turn of the 17^{th} and 18^{th} centuries), the steam engine (18^{th} century), or electrical appliances like the telephone exchange (early 20^{th} century). Each of these comparisons referred to the latest, technologically most advanced development at the time, the machinery and technical equipment in widespread use. They served to grasp (in the sense of a metaphor or as a model) one of the attributes of Man – from the construction and mechanisms of his body, through his life functions, to the intellectual processes. Newer and more integrated, complex versions of Machine Man appeared as new technologies developed with an increasingly complex mechanical construction and functional character, and consisting of new materials.

At the turn of the 1930's and 40's electronics and information science contributed to the creation of yet another embodiment of the old myth. Digital computers, which on account of their computational powers many times that of Man's intellectual capacity for routine calculation were for a period of time called "mathematical machines," became Man's most useful instrument for practical and research tasks. Like every other instrument, the computer is a reflection in the most general sense of some of its creator's qualities and attributes. In the case of digital machines, however, particularly as regards the awareness of their constructors and users, we are confronted with a special situation, which is given such prominence by researchers of artificial intelligence. As D. Bolter writes (p. 43), by constructing an intelligent machine, Man creates himself anew, Man redefines himself as a machine. The relationship between Man and an instrument constructed in such a manner and with such powers acquires a special anthropological significance. "A relationship with a computer can influence people's conceptions of themselves, their jobs, their relationships with other people, and with their ways of thinking about social processes. It can be the basis for new aesthetic values, new rituals, new philosophy, new cultural forms," writes S. Turkle (p. 166).

These statements essentially refer to a universal relation which may be discovered in any age defined by a specific technology. One of the properties of the age of micro-electronics and the information technologies is that for many researchers and theoreticians of information science, as well as for many scholars in the humanities, this technology seems to suggest a virtually unlimited potential for the simulation (modelling) of Man's intelligence. For some, simulation is tantamount to intelligence: computer software is mind, and hardware is body. Such controversial hypotheses can hardly be acknowledged as satisfactory conclusions made on the grounds of unquestionable facts. Nonetheless they warrant a critical analysis, which could reveal many a mythical, ideological assumption behind them.

Human and machine intelligence. The interpretation of Man's intelligence in terms of information science is justified to a certain extent. The cybernetic character of cognitive psychology and the cognitive sciences, and their approach from the point of view of information science is helpful, chiefly for its quantitative methodology, in the study of human psychology. Thanks to this, as most psychologists now agree, a description and definition has been obtained for what is known as "general" intelligence. It is assumed that one general and universal factor lies at the foundation of human cognitive operations like abstract thinking, drawing conclusions, making decisions, learning, solving problems etc.

It may be examined and tested experimentally; it may be presented quantitatively and in terms of a model. Next, the way such a model works may be computer-simulated. The computer program for this kind of model may be implemented and run on more or less any digital machine, to obtain more and more accurate and closer approximations of simulations of the operations of human intelligence. The computational complexity and multi-modularity of such programs written in compliance with the genetic algorithms model simulates more and more comprehensive and complex cognitive operations, including those of their transformations which are evolving in an unforeseeable direction. These programs are self-propagating, and serve to produce new programs; they are highly effective, although their operations are not fully understood. As regards the other, hardware aspect, the introduction of computers which process data in parallel and the self-programming networks operating on their basis which imitate the processing (digital-analogue) activities of the human nervous system are another step forward to a good re-creation of the specifics of natural intelligence. Nevertheless, the question remains open whether the essentially digital, intermittent and algorithmic character of the computational procedures going on in a computer is the right instrument for the creation of a model of the continuous, substantially non-algorithmic operations performed by humans. In spite of the possibilities of digital machines and their programs to obtain partial models of the variability and evolving nature of natural phenomena, including intellectual phenomena, there still remains the question of the qualitative incommensurateness between human and mechanical intelligence to consider.

Thus ambiguities and misconceptions within the theory of artificial intelligence arise due to too broad an understanding of the term "intelligence." This predicate is ascribed to a specific class of digital machines on the grounds of an analogy with certain human behaviours and the procedures followed by digital computers in operations like proving mathematical and logical hypotheses or identifying meanings in natural language. From the analogy between the operations of the two systems (albeit accomplished on two different levels and by different mechanisms) a conclusion may be drawn that what determines the essential nature of intelligence, both human and mechanical, is the outcome of the operation, not the operation itself. The function of the operation, the accomplished aim, is more important than the active material, its structure, or the stages of its work. The irrelevance of the actual material, the physical base in which intelligent operations are carried out is one of the key principles of the theory of artificial intelligence.

The processing (computation) of appropriately encoded signs and symbols, performed in accordance with strict rules of transformation, is recognised as one of the constitutive properties of intelligence, both in the general and in the abstract sense. Intelligence is attained by any system with an arbitrary, non-existent qualitative characteristic which processes information and/or transforms linguistic expressions. As H. Simon writes, "We have learned that intelligence is not a matter of substance – whether protoplasm or glass and wire – but of the forms that substance takes and the processes it undergoes. At the root of intelligence are symbols, with their denotative power and their susceptibility to manipulation. And symbols can be manufactured almost of anything that can be arranged and patterned and combined. Intelligence is mind implemented by any patternable kind of matter." Living organisms and computers are exemplars from a general class of systems which may be defined as intelligent in the same manner, since they all operate on symbols. "They achieve their intelligence by symbolizing external and internal situations and events, and by manipulating these symbols." (p.35-37)

This purely formal character of the definition of intelligence is partly justified by its local and mathematical point of departure from computer science and the theory of artificial intelligence. The basic structural and operating principles of digital machines are an implementation of Turing's machine, which was created as a purely theoretical concept to prove the insolubility of the problem of recurrent functions. The results of research by A. Turing and A. Church (the Turing-Church theorem) showed that a mathematical machine, for example constructed to prove the truth of a given statement in a finite procedure, for which there is a program, has essential limitations. There exists no universal algorithm to show that the machine in question will complete its task; for a machine of this type there is no solution to the stop-problem.

The formal limitation of Turing's machine (like Gödel's incompleteness hypothesis) also indicates the basic limitation of the computational operation which is the foundation of the algorithmic processes in digital machines. Paradoxically, it accompanies and coexists with the increasing computational power of modern computers, which it neither undermines nor restricts, since both these properties (the formal and the technical) of digital computers are achieved on equal levels. This fundamental idiosyncrasy is worth recalling, as in the theory of artificial intelligence for a long time now a discussion has been going on which may be boiled down to the question whether the mind is a machine and whether it is

subject to the same limitations as the ones described by the Church-Turing theorem.

Is Man a machine? This discussion is an example of how formal deliberations from the field of mathematics and computer science exert an influence on questions in psychology and philosophy, focusing on the old problem of the nature of the mind. From the theoretical and methodological point of view, this problem has not been highlighted up to now by any special conclusions and is full of misconceptions, but nevertheless is an interesting example of the impact of information science (its engineering aspect) on contemporary Man's self-reflection; an investigation into this problem from the socio-psychological point of view is thus an interesting and useful undertaking.

A comparison of Man and digital machine is as signal as it is difficult, and more often than not is conducted in an erroneous way and is thereby confusing. An example is the standard question often asked in the theory of artificial intelligence, "Can machines (computers) think?" This question implies that the thinking (intelligence) of digital machines means doing the same things which when performed by human beings implies they are intelligent. "Artificial Intelligence is the science of making machines to do things that would require intelligence if they were being done by people," (Minsky, p. V). This attitude begs the question, effectively anticipating an answer in the affirmative to the question whether intelligent "thinking" machines can exist, since the comparison in it involves only the results of operations conducted by humans and machines. We fail to notice that machines of this kind have been in existence ever since the earliest stages in the development of human civilisation, when Man began to resort to a number of machines and technical appliances which worked for him in various ways, assisting him in activities requiring intelligence. Even the simplest counting machines, the abacus and mechanical computational machines meet this criterion. The reduction of the essential functioning of a complex system which performs a given operation solely to its effect leads to a trivial and cognitively irrelevant conclusion. The core of the problem of a comparison of Man with machines must lie somewhere else.

The really important and interesting question cognitively, anthropologically and even ethically, is the issue expressed as follows: "Does Man work (think) like a machine?" This is not a straightforward re-worded version of the previous question, although it is relevant in connection with the issues which researchers of artificial intelligence are working on. In fact the age of digital machines and information technologies is putting the traditional search for the mechanisms present in human actions and thinking (Man's operations and his artefacts) in a new light. Thanks to digital models and simulations we can learn more about the "machinery" present on many levels and in many kinds of human experience and in the human environment; in this sense computers are proving both useful tools for discovery (because of their high degree of cognitive resolution), as well as resourceful models for certain aspects of the phenomena investigated.

So what kind of machine is Man? A correct and successful examination of this question and an answer to it will depend on the level of description and the perspective and methodology the researcher adopts for a study of the analogies between machines and Man. Without a specification of which level of Man's structure, which of his activities, which of his associations with his environment are meant it will be impossible to apply the machine metaphor.

Man, his simple and his complex life processes, the way his body works (his nervous system, especially his brain), his practical and intellectual activities, his material and spiritual artefacts, his co-operation with other humans, as well as the social and cultural forms of this co-operation – each of these aspects can be examined as a variety of different mechanisms. The terms "mechanism" and "mechanical" here denote the same as "determined," "subject to rules and laws," implying a cyclical character in terms of time and space, repetitiveness and sequencing. In this sense the mechanical nature of the physical and chemical processes going on in the human body at the elementary level of its structure (cells and tissues) differs fundamentally from the mechanical nature which may be observed in some (not all) of the typical operations and structures (again not all of them) of Man's artefacts. Although there is no single mechanical model for these different levels which would describe all of them fully, in the same manner, and efficiently (irrefutably, without evoking dissent), the mechanical nature of Man, understood in this sense, is a fact. While none of the existing machines is a perfect model of the human "machinery" understood in this sense, nevertheless certain machines (including both digital and analog computers), may be legitimate models for particular component parts or aspects of Man.

On the other hand, from the complex systems perspective, in the entirety of his structure, in the complexity of his life functions, in the general principles and rules of his operations, and in the full set of his relationships with the world, Man is not a machine in any way, he is not a mechanism. In his biological body, the subject of practical, social, and political activities, the subject of ethical and aesthetic judgements – in all of these aspects Man does behave in a complex way, but basically not mechanically, not subject to determinism. Even if there are mechanisms in him at a lower level or in some of his component parts, there are none at the higher levels and none in Man as an integrated entity. The complexity of human structure or operations seen as a complete entity is not the simple sum of the parts; the complete and complex human entity is something more than just the

collection of all the component parts. The emergence and uniqueness of the phenomena on the higher levels of Man's structure or operations effectively undermines the reductionist view that there is a specific mechanism behind the complete entity (or its successive levels). If there are characteristic mechanisms in the particular component parts and on the particular levels of the human entity, they are not always the same mechanisms.

Moreover, the complexity of Man as a complete entity, and of the component parts of his structure and operations, are essentially dependent on the complexity of the environment in which he lives and is active. The complexity of each of these aspects of Man is a function of the complexity of his surroundings. This shows that there can be no single mechanism in him, and thus no single formal (computational) model of him.

In order to obtain a simple picture of the essence of Man it is necessary to reduce his internal and external complexity and to present him as a relatively simple system. Such a reduction is warranted methodologically and didactically, but it may lead to unwarranted ontological and anthropological conclusions, to oversimplifications: it is precisely this kind of situation that occurs in the theory of artificial intelligence and in the cognitive sciences.

Designers and theoreticians of intelligent machines who assume a position from the vantage-point of information science in their interpretation of Man, and especially his cognitive operations (his mind), are brought to a radically mechanistic and reductionist view in which there is no room for a consideration of the subtleties and complexities described above. An example is provided by H. Simon's remark: "Today, although we do not know what protoplasmic processes correspond to the elementary information processes, or how these processes fit into the architecture of the brain, we do have a proof that such processes *can* be provided with mechanistic explanations, for although we do not know how the elementary symbolic processes that are capable of explaining thinking are accomplished physiologically in a digital computer we do know how to obtain them electronically in a digital computer. The possibility of providing a mechanistic explanation for thinking has been demonstrated by programming computers to think." (p. 271) The mechanistic (computational) image of the human body and mind is an idiosyncratic *ad hoc* hypothesis, the (indeed partly irrefutable) proof of which is the effectiveness of computer technology. The effectiveness of computers is supposed to prove that Man is a special kind of computer. In fact, however, the theoreticians of artificial intelligence are resorting to assumptions corroborated by the suggestive metaphors and figurative language. Expressions like "Man is a processor of information," or "Nature is the data for processing" make a profound impression on ordinary people, but they provide no grounds for a thorough rationalisation and verification of such hypotheses.

The tenacity of the myth of artificial intelligence. There are many reasons behind the popularity and impact intensity of theories which forecast the possibility of intelligent (thinking) machines being constructed. Building machinery to assist Man is, after all, an aspiration with a pretty long tradition. Many devices, such as the mechanical and electromechanical machines designed by Schickard, Pascal, Moreland, Leibnitz, Babbage, Hollerith, Bush and others, worked by reproducing Man's computational skills using a variety of mechanisms. Technology, with its successes in engineering and computation, stimulated the genesis and development of philosophical notions of artificial intelligence. The creation of more and more efficient computing machines gave rise to the belief that the performance of computation by a machine may be extended to include other intellectual operations, providing they could be reduced (remodelled) to the transformation (computation) of expressions carrying a meaning. New technologies (new materials, better principles of construction) encountered new mathematical and logical theories. An excellent example of this is offered by the designs produced by C. Babbage for a differential and analytical machine working on the principle of turning logic into algebraic expressions and reducing all of mathematics to logic. The idea of "mechanisation" which appeared in the late 19th century related both to technology and to the formal sciences. These were the roots of a number of later inventions of electromechanical machines, and of some epoch-making discoveries in mathematics, chiefly of automation. They were also the roots of computer science in the sense of theory of programming and data processing.

The point in time when this trend in technology and intellectual pursuits intensified came with Turing's theoretical and philosophical concepts. His design made it perfectly clear that the operation of algorithmic computing was inherently limited, but even Turing himself insisted that the digital "computer" – a term which originally referred to an individual who was perfect at doing calculations – was a model of the human mind (or at least some part of it). He wrote that although he thought the question "Can machines think?" too vague to be worthy of attention, at the same time he believed that by the end of the 20th century the way people spoke and thought would have changed so much, that there would be no voices of refutation raised whenever thinking machines were mentioned. "The original question, 'Can machines think?' I believe to be too meaningless to deserve discussion. Nevertheless I believe that at the end of the 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. I believe further that no useful purpose is served by concealing these beliefs." (p. 442) His statement is a perfect illustration of how, despite his awareness of the formal limitations of his digital machine (for there is a broad class of problems for which there are no corresponding algorithmic solutions) and of its inability to simulate all the physical processes (since it could reproduce only discontinuous processes), Turing, and others following him, still clung on to the "behavioural" aspect of the digital computer's operations (viz. function was more important than physical material). If examined and assessed on this level and compared with Man, then indeed computers appear to be Man's rivals, or even outright winners in the intellectual competition against him. While this is partly true, it does not reflect the true nature of the two physical systems and their mutual relationships, and effectively only obscures the reality and produces a false image.

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To sum up the theoretical and cultural premises to the emergence of the theory of artificial intelligence and the myth of Machine Man, we should observe that it is based on numerous simplifications and methodological errors. Some obvious facts relating to hardware parameters, formal properties of programs and the art of programming, and the development trends in computer technologies have been hailed as sufficient grounds for such far-reaching conclusions of an epistemological and anthropological nature, while the level of description has been confused with the level of forecasts, and facts with standards.

It is thus chiefly the effectiveness itself of the operations of computer programs used to simulate natural phenomena, including psychological phenomena, which has been acclaimed as a sufficient proof of the "programmatic" nature of the mind and Man in general. Very often the mathematical model constructed by the application of logical and informational formalism for a quantitative presentation of a given phenomenon is regarded as a theory for the simulated phenomenon. A phenomenon's model or digital simulation, which has already been constructed deterministically in the formalist approach, is further limited through the technical parameters of the computer on which it is performed and for which it is made. None the less, this double limitation – ubiquitous in most of the natural and mathematical sciences – is being notoriously ignored and not taken into consideration in theories of artificial intelligence. The results achieved in the construction of machines, regardless even of the specifics of the technological level involved, are being held as sufficient grounds to justify a computational view of Man.

Another factor contributing to the emergence of the computational (programmatic) interpretation of the mind, alongside the cognitive reason, is that artificial intelligence theories are devised in the community of mathematicians, logicians, and programmers, whose workshop, definitions and terminology exert an influence on their attitudes and views on psychology and philosophy. These people are attuned largely to the formal, and not to the material (physical and biological) properties and conditions of the thought process, which for them is like a kind of program-writing and -running. Their definition of thinking (the mind) has the attributes of a classical definition, in the form of the following hypothesis: "thinking (the mind) is a program consisting in computation," in which the term "mind" is a *species*, "program" is a *genus*, and "computation" is the *differentia specifica*. We may have serious reservations about this kind of definition, for example that it does not have the character of an objective statement (it is only formulated in an objective style) and it arbitrarily correlates species and variety in terms of specific difference.

Not only is the manner in which theoreticians of artificial intelligence link mind and program together in a definition controversial, so are the psychological implications they draw from it. These are patent in the sociological study conducted in the 1980's by S. Turkle, one of the principal researchers in American universities involved in programming and the construction of digital machines. These people have made statements to the effect that thanks to the specifics of programming they perceive themselves as the "builders of their own minds," liberated from matter and not concerned with anything except their own imagination. For them the world has only a formal meaning, and it is not as important as the mind, which is a universal principle not bound to any special substance. Minsky has said that he is able to program a machine only to the same extent that he can understand himself when he is able to carry out a simulation of a given cognitive operation which is then to be performed by a machine. This idiosyncratic kind of introspection characterising programmers helps them to make successful programs, but it also gives rise to a belief in the programmatic nature of the mind, and in effect generates a singular view of Man. "The AI scientist," writes Turkle, "belongs to a culture deeply committed to a view that thought does not need a unitary agent who thinks. Farther on we shall see that this culture has now built up an arsenal of metaphors, images, and turns of thought to support this position. Their coherence is the coherence of a culture: the culture of a system, of process, of simulation. 'Indeed,' quipped one of its recursively minded members, 'it is more than a culture, it is a simulation of a culture.' . . . Debates about what computers can or cannot be made to do ignore what is most essential to AI as a culture: not building machines but building a new paradigm for thinking about people, thought, and reality . . . Whether or not AI can make robots with superhuman powers has material consequences of the first magnitude. But it is far away. What is here and now is the challenge of a new philosophy." (p.267-268) This philosophy, the myth of Machine Man (and the myth of the thinking machine), is as vigorous as the research on intelligent machines is widespread, and as computer science is becoming more and more advanced. These two motifs are so closely interwoven

that it is becoming harder and harder to distinguish between them, label and assess them.

Does this situation give rise to any special threats? Yes and no. First, it is typical of most ages described by some "defining technology," as Bolter writes (p. 12). Instruments and machines for discovery and production have always been perceived as secondary, derivative; in the theoretical sphere as metaphors or models (theories) of some aspect of the world or of Man; for a time they would be useful, later they became obsolescent and were disused, they ceased to be intellectually fashionable. Secondly, the machine metaphors and models created by constructors and engineers usually enjoyed a narrow range of impact; at most they got philosophers and writers enthusiastic about them; usually they were devised outside the sphere of technology itself.

In the case of computer science the situation is far more complex and ambivalent. The material, financial, and intellectual effort being put into the construction of thinking machines comes from two sources: the real potential of technology, and dreams and ambitions. In fact every technological invention is a combination of these two elements. In the case of the theory of artificial intelligence this relation is special in that the latter component is overshadowing the former. The research projects in mathematics, logic, programming and engineering have to a large extent been embarked on due to the researchers' dreams and visions, a good example of which is Turing and the first generation of researchers of artificial intelligence (Minsky, Simon, McCarthy). While perceiving themselves as computing machines (Turing originally used the term "computer" to denote someone who is perfect at doing calculations to prove hypotheses) or as processors processing data, they have been and are constructing their machines in accordance with the laws of logic and information science, which always impose limits, and at the same time in accordance with models (viz. idealisations, and therefore with no limitations) of their own cognitive operations. On the other hand, they think of themselves as machines because they are using digital machines, in other words their belief that they will be able to construct a thinking machine is a feedback effect of the machine on its maker and user. Here the ideal (not the plan) determines the actual artefact, but it influences the structure of the artefact through the awareness, imagination, and self-reflection of the human building it. Nonetheless, its impact is strong enough to endow the machine's construction plan with a substantial charge of the idealised component. In Turing's machine there is a patently large presence of these simplifying components, in effect misrepresentations of the nature of the mind and cognition. Appended to all this are the personal views of computer engineers and users' social expectations, which complete the picture of the myth of Machine Man and the thinking machine. Failure to notice and differentiate between these mutual relationships means succumbing to the myth which is being created in the theories of artificial intelligence. Like every other myth, this one, too, needs to be brought down to earth and rationalised, and its symbols and metaphors replaced by rigorous scientific analysis in a cultural context. Only then will the diverse theories be liberated from the emotional, irrational and stereotypical burden on them. After the ideas and concepts have been rigorously analysed, at least the threat from the terminological and methodological muddle will be gone. We may expect that in this sense there will also be an attenuation in the ethical (worldview) threat in information science and its vision of Man using more and more intelligent computers.

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