

INFORMATION, HEURISTICS, CREATION

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A general scheme for a general theory of information taking into account artificial intelligence and phenomenological processes of matter is proposed.

INTRODUCTION

Today it is easier to speak about the technology of information and of the economy of information than about a science of information. What is information from a scientific point of view? Fortunately, the advent of artificial intelligence (AI) and its similarities and differences with the natural intelligence (NI) of man may help get an answer. Since NI has a biological substratum and in any biological being information plays an important role, it is necessary to investigate the reason why the living matter uses information, the natural non-living matter does not use it (if this is quite true) and the artificial technological matter may also use it as can be seen in intelligent robots.

For a general scheme of a theory of information it is supposed that:

- (I). Matter is of four kinds: a) profound matter; b) non-living matter; c) living matter; d) intermediate matter.
- (II). Information always manifests itself on a material substratum.
- (III). Although matter is fundamental, information is nearly at equality with matter, therefore is present beginning with the profound matter.

Profound matter, after Aristotle [1] [2], has two principles, which may be interpreted now as nonstructured matter and matter which can give form to the previous one by information. This informational matter, in which information cannot be originally structural in the usual sense, has been called informatter [3]. The information in the informatter is supposed to be of the nature of phenomenological senses of the human mind and perhaps of any living being. The phenomenological information of the informatter is a physical process with a special property of sensibility of this profound matter. The phenomenological sense of the mind is of the same nature and therefore it is supposed that any living being has, in a way, access to the informatter of profound matter. On the contrary, the non-living matter gives no access, the informatter being covered by the structured (formed) matter. Therefore, both non-living and living matter are built with the same ingredients, but the living matter still has, for some reasons, access to informatter. Seen from the outside, non-living matter is structural and, may be said, formal. Living matter is

structural-phenomenological or formal-nonformal. Non-living matter has also at its origin an informational phenomenological source; living matter is always informational [4].

COMPONENTS OF INFORMATION

Alongside with the phenomenological information (profound senses and mental senses) and the structural information, which needs no other explanation, a third component of information is significance. The importance of such a component is tested in AI where significance acquired by semantic networks, frames, etc. is a formal meaning.

For NI, meaning is formed by two components, significance (formal meaning) and phenomenological sense [5], where significance has, in its turn, according to Mario Bunge [6] two components,

significance (M.Bunge's meaning, in fact, formal meaning) = context significance (M.Bunge's sense) + reference significance (M.Bunge's reference).

Significance is built into AI systems and it may exist in the neuron machine of the brain. The most complete information is then [7],

$$I = \langle S, M \rangle \quad (1)$$

where S is the structural information and M is the meaning of information

$$M = \langle G, s \rangle \quad (2)$$

In (2), G is the significance and s the corresponding phenomenological sense. Because

$$G = \langle C, R \rangle \quad (3)$$

where C is the context significance and R the reference significance, then, from the above expressions it follows

$$I = \langle S, C, R, s \rangle \quad (4)$$

Such information characterizes the human mind. Artificial intelligence is characterized by information without phenomenological sense

$$IAI = \langle S, C, R \rangle \quad (5)$$

AI is born from NI, even if afterwards AI can develop its own information content. Therefore (4) is mental-psychological information and (5) is reduced AI information. In most cases (4) and (5) are equivalent because there is a static correspondence between G and s, but when one manifests structural or phenomenological heuristics there is a transitory period before a new correspondence between G and s is established. AI may know a structural (formal) heuristics but

not a phenomenological heuristics. NI may know both, formal heuristics and phenomenological heuristics, and more, formal heuristics may induce new phenomenological senses and viceversa.

Some more reduced information is the structural information under its syntactic form

$$I = \langle S \rangle \quad (6)$$

but this information has a reason only in connection with NI or AI. It is the usual form in which information has been considered until recently.

OTHER CASES OF INFORMATION

If informatter is generating phenomenological information by physical fluctuations, when informatter is coupled with nonstructured matter, a physical universe is born. The physical universe is based on the information of the form

$$I = \langle sUniv , SUniv \rangle \quad (7)$$

where $sUniv$ is the generated phenomenological information and $SUniv$ is the corresponding physical structure of the Universe, playing the role of the structural information to be implemented physically. The programs or the laws of an Universe may be considered as given by the profound information

$$I = \langle sUniv \rangle$$

or by the corresponding structure of the universe $\langle SUniv \rangle$. Man and society can understand this structure as information by knowing the structural, that is, the physical laws of the Universe.

For a biological universe, through the "free" informatter of the living beings, new phenomenological sense may appear, induced by a structural phenomenological interaction or by the processes in informatter itself. Then,

$$IBiol.Univ = \langle U , sUniv , SUniv , sBiol , SBiol \rangle \quad (8)$$

where $sUniv$ and $SUniv$ have the same significance (or meaning) as before; $sBiol$ and $SBiol$ the new senses and the corresponding physical and informational structures; U is a symbol for the physical availability of senses of informatter. At any moment new senses appear and disappear. They can be maintained only when they are transposed into structural information which can regenerate these senses.

A biological cell has the information,

$$I = \langle SFiz , SInf , s , U \rangle \quad (9)$$

where SFiz is, for instance, the genetic information, SInf is the dynamic information of the cell due to its functioning, s are the corresponding phenomenological senses and U is the availability for new phenomenological senses.

In (7), (8) and (9) a formal significance is lacking and consequently it is doubtful that any of these objects has an intelligence. The phenomenological senses cannot be used to process their own information, on the contrary, processing of information may be done by some type of computer, therefore by physical or informational structures. So, the condition of significance is obligatory for intelligence.

This condition may be fulfilled only by objects with a nervous system or with some other types of processing structural information with significance, that by NI and AI.

The biological cell and the plants are not intelligent although they know structural-phenomenological interactions. The physical universe is not intelligent, the profound matter is not intelligent, only the biological universe may be intelligent if it contains animals with nervous system that works and build AI.

A special case concerns the information at the social level, but this is a very large theme in itself.

HEURISTICS AND CREATION

Heuristics may be of two types :

- a) structural-heuristics;
- b) phenomenological heuristics.

A structural heuristics is described in artificial intelligence as informal rules of thumb to solve a problem, that is to change the structure of an initial state into the structure of a goal state [8]. Phenomenological processes are nonformal. Structural heuristics applies to old structures giving new structures using informal rules, which are in fact formal. The heuristic rules formalize what is not coming from a complete formal theory, and with this significance the heuristic rules are informal. But, in fact, structural heuristics is formal heuristics.

What is obtained by structural (formal) heuristics, although it may be new, is not creation. It is the result of a play with formal structures. An AI system with heuristics does not create. When the creative insight of a man becomes a rule of thumb, an informal procedure for heuristics, it is not heuristics that create a new structure, but the creative man. It may happen that a new structure generated by an AI system to be created by a man, by a phenomenological or a creative procedure (as described below). In such a case the formal heuristics looks like a creation. But it is not a creation yet, because of the formal internal procedure. Sometimes, in such cases, the formal heuristics is called creation of the third species [4].

Formal heuristics may also be used by NI, not only by AI. But in the case of NI (of man), because of a structural-phenomenological interaction, it is very difficult to distinguish between formal and phenomenological heuristics. It is to be expected that the formal heuristics is

enhanced by the phenomenological heuristics. Phenomenological heuristics may take place even independently of the formal heuristics, due to the property of generating phenomenological senses. These are then crystallized as neuronal structures. Because of the advanced degree of novelty brought about by the phenomenological heuristics, this may be called a creation of the second species.

Creation (true creation, creation of the first species) implies a conscious control of formal heuristics and phenomenological heuristics, an iterative interaction between these two types of heuristics, in order to obtain the new phenomenological sense and the corresponding significant structure that satisfy a tendency, a desire, an expectation. Creation is a conscious imbrication and iteration of the two types of heuristics. Creation does not come from anything, but its result may be very far from what is known, although the point of departure is old structure and old phenomenological senses, respectively.

AI does not have creation because it does not have phenomenological senses (because AI is not alive). AI has only structural heuristics. A biological cell does not have creation because it does not have consciousness; it cannot have a conscious control of the structural-phenomenological interaction. But the cell still has a non-conscious structural-phenomenological interaction and phenomenological heuristics may bring new structures. The cell has a creation of the second species, that is, phenomenological heuristics. This could have contributed to the process of evolution together with mutations (structural heuristics) in the frame of the natural selection process. The profound matter does not create because it does not have consciousness and it does not process structures with significance.

FORMAL AND NONFORMAL SOLVING PROBLEMS

For a class of problems to be solved, if it is to build an AI system, this is conceived by a man or by a human team. This man or this team does not only function in a formal way, they have phenomenological heuristics and creation as two important functions. Their behaviour is formal, informal and nonformal. Their problem is to build a problem solver using AI methods. But he or the team is a natural problem solver, that is they represent NI. After NI has built an AI system, the latter is not let to work alone. In terms of the "problem space" the AI system may be confronted with formal subspaces but also with nonformalized subspaces of the problem space. In order to formalize the nonformalized subspaces AI may use structural heuristics and if it does not succeed NI must be called for. Therefore, in general, AI and NI are working in symbiosis. We do not have a theory of this symbiosis. NI has not only intelligence in this symbiosis for solving problems: it has also intuition, creation and reason. NI and AI determine together a new social intelligence [9]. Solving problems at social level and at global level is one of the challenges of the social intelligence. The intermediate matter made of non-living matter and intelligent information, that is information with significance, will it help us build a socio-human civilization? We hope that this will be the case.

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