Dialectical Understanding of Information in the Context of the Artificial Intelligence Problems

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Abstract. It is shown that the implementation of breakthrough progress in artificial intelligence cannot be accomplished without a radical modernization of the methodological framework for research in this area. This upgrade can be performed only with the use of conceptual and methodological apparatus of dialectics. Its consistent application to objects, in either case connected with ideas about the intellect, results in the formulation of the dialectic symmetry principle. The first practical steps for the implementation of the proposed concept in practice are associated with the creation of a new education paradigm, which operates, including ideas that “education” being understood as a public institution, is not reducible to individual learning. Education in modern conditions can and should be viewed primarily as a tool to influence public consciousness, or more precisely, its subsystems.

1. Introduction

The problem of artificial intelligence (AI) is becoming one of the main areas of research related to the emergence of the digital age [1]. The most controversial issue that arises when discussing the essence of AI, obviously, is the issue of the nature of intelligence as it is. Currently, this issue is not abstract and theoretical but of immediate practical significance, including in connection with the development of tools to adequately manage the information flow in society.

They have repeatedly tried to give an answer to it from various positions [2],[3], but all these have very definite disadvantage associated with the fact that the concept of “intellect” is inseparably linked with the concept of “information”, which until quite recently has had no consistent interpretation in the literature.

Indeed, the “intellect” certainly is a kind of essence of a purely informational nature. Thus, the human mind is a result of the exchange of signals between neurons in the brain, each of which performs relatively simple functions. We say that consciousness is a system property, but in itself this statement only states a fact that is obvious to date - it is not reducible to the properties of individual neurons, it is a new quality that appears in a complex system due to the presence of an extensive system of connections between its elements.

We do not put a sign of identity between “intellect” and “consciousness”. As a working model for our reasoning, we use the approach of D. Dennett. It represents consciousness as an integrated system of psychological states of a person, mutually related with each other. New information is correlated with the previously obtained. Intellect does not exhaust consciousness completely [4].
In this paper, an attempt is made to show that human consciousness is the result of self-organization processes, only indirectly related to a material carrier; it is a self-organization of certain entities that have a purely informational nature. We emphasize that at the present time it is already possible to say with certainty that in many complex systems of different nature, non-trivial informational entities that are only indirectly connected with material information carriers arise in many complex systems of different nature. Such informational entities have their own behavior, and it is often difficult to detect the manifestations of their properties by studying the behavior of the elements of the system separately. An example of a non-trivial informational entity of this kind is bureaucracy - the result of the processes of informational self-organization in administrative systems.

As shown in [5], bureaucracy is a kind of remote equivalent of a biological organism, which has a pronounced equivalent of the self-preservation instinct and its own "goal setting", the character of which, as a rule, has nothing to do with the tasks for which the administrative apparatus was originally created.

This conclusion is confirmed by simple mathematical models, in particular, the voting model in the academic (or other) council [6],[7]. In this model, each member of the voting board is assigned to a separate neuron, and the voting procedure is considered as a change in its output state (“In favour”, “Against”, “Abstained”) depending on the array of information received at its input (for example, the content of the report thesis). In the cited work it is proved that, provided that the density of connections between the elements of the system is sufficiently high, the de facto decision is made not by the set of council members, but by the neural network formed by them. (The nature of relations between council members is determined by their mutual influence on each other; for example, a council member can vote “Against” if a student of his opponent defends himself even when the dissertation is quite decent).

2. Dialectical understanding of information

Studying the processes of self-organization of entities of informational nature is a nontrivial task, since they are unobservable. Any conceivable experiment, one way or another, can provide information only about changes in the state of material bodies - information carriers, it is possible, therefore, to judge the processes of self-organization of information entities only from indirect data. (In particular, this applies to situations where information is distributed, as is the case in neural networks).

When studying the behavior of entities of informational nature, it is methodology that comes to the fore. Indeed, you need to have a theoretical tool that will allow you to adequately interpret a large array of experimental data and bring them into a form that allows you to judge what is happening in the communication shell of a complex system. The basis for the development of such tools can obviously be only a methodology that is obviously insufficiently developed for information theory, because until very recently there was no adequate interpretation of the very concept of “information” as such.

As shown in [8], this interpretation can only be given by means of philosophy, since the concept of information is among the fundamental. More precisely, this concept can and should be viewed precisely as a category of dialectics. In particular, this means that the study of problems associated with the concept of “intellect”, in particular, the most fundamental problems of artificial intelligence, cannot be conducted otherwise than with the involvement of an apparatus of objective dialectics.

Hence there is a need to create our own methodological basis for the theory of artificial intelligence, which is fundamentally different from the one that is currently in use. In fact, the methodology of work carried out in this area does not differ from the methodology used in the development of classical computing devices. Obviously, sooner or later it will be necessary to go beyond it, since AI systems must necessarily be something qualitatively different than existing digital devices.

The basis of the proposed methodology can be briefly defined through the “dialectic symmetry principle”. Consider the grounds for the promotion of this principle.

As noted in [8], information is one of the fundamental concepts widely used in both the natural and human sciences. Therefore, talking about the “definition” of information in the sense of school definition seems to be unjustified. To define in such a context is to reveal the content of one term using others. Such reductionism does not work for fundamental concepts.
Consequently, there must be certain basic categories that are not disclosed through any other, i.e. to give them a definition in the classical sense of the word is really impossible because of their fundamental nature. Dialectics defines such categories through opposition.

There are a number of paired dialectic categories: content and form, quantity and quality, etc. They do not have the usual, “school” definition precisely because of their fundamental nature. These concepts include, in particular, the category of matter and information [8]. It is curious to note that the philosophical interpretation of the category “matter” experiences the same difficulties as the definition of the “information” category, despite its historical background.

In materialistic philosophy, it is defined as follows. Matter is a philosophical category for the designation of objective reality, which is given to man in his sensations, is displayed by our sensations, existing independently of them. Or “from the point of view of dialectics, matter is objective reality - the reason, the basis, the content and the carrier of the whole diversity of the world” [9].

Until recently, in the materialist dialectics, the category of matter has occupied a special place, i.e., not having a pair. Realizing that the basic categories cannot be defined in any other way except through opposition, the experts on this issue left the category of “matter” (in this sense) aside.

Difficulties are removed automatically, if it is recognized that “matter” and “information” are paired dialectic categories. They, like others, should be defined only through opposition. There is a point of view according to which information is contrasted with energy [10]. However, it cannot be considered consistent, since motion is a form of existence of matter.

The nature of objective reality is dual, which in one sense or another has been recognized and is still recognized by all schools of thought. Any objectively existing object contains (we state it this way, for lack of a better term) both material and informational components. For example, by studying specific water samples, you can get information about water as such. Simplifying, in a separate water molecule there is information about all such molecules.

The proposed approach, which can be called the principle of the dualism of matter and information, automatically puts everything in its place. However, using the opposition formulated above, at first glance, the constructive of the definition of information disappears; it becomes too general to be used for practical purposes.

The constructive of the definition of information given through opposition is expressed in that on this basis it is possible to formulate the dialectic symmetry principle. (As it is known, many important scientific results were obtained precisely on the basis of considerations of symmetry, for example, the Onsager principle).

Similarly, the principles of symmetry can also be applied to the opposition of matter and information, considered as paired dialectic categories. First of all, it follows from this principle that just as there can exist an infinite variety of forms of matter, just as there can exist an infinite variety of forms of information. Matter can be inert, and can also be alive, therefore, symmetrical concepts must exist in relation to information; This creates additional opportunities for the study of nontrivial informational entities arising in complex systems by philosophical methods.

Further, it is precisely the principle of dialectic symmetry, associated with the duality of matter and information, that makes it possible to adequately interpret the relationship between what is called “energy” and what is called “information”. As you know, there are numerous speculations about the question of whether information can have "energy" and the like. Refer to table 1.

**TABLE 1. TO ILLUSTRATE THE DIALECTIC SYMMETRY PRINCIPLE.**

| Substance | Energy |
|-----------|--------|
| Information | ?      |

“Factor X”, indicated by a question mark in this table, has no name yet and, apparently, has not even been discussed in the scientific literature (in any case, it has not been widely discussed). However, judgments related to this factor already exist in the mass consciousness. So, it is customary
to talk about a person’s positive or negative “energy”, mental energy, there are also ideas that
information can somehow be converted into energy and/or be considered as its form.
Analyzing the entire spectrum of such judgments is obviously meaningless, since nothing stands
behind them, except for certain intuitive considerations that remain unprovable.
You can do it easier - remember the genesis of the concept of “energy” in its modern interpretation
and try to act - or outline a plan of action – in a similar way.
If we turn to the history of science, we find that the concept of “kinetic energy” was first used not
long ago, in 1829 (the work of G. Coriolis). The concept of “potential energy” is even later - 1853 (U.
Renkin); by historical standards it is the most recent.
Initially, both of these concepts appeared as the result of a mathematical study of equations
describing the motion of a material point. What later became the formula for kinetic energy — the
product of mass and the square of velocity — appears as the first integral in solving a second-order
differential equation that does not explicitly include the time variable. The situation is similar with
potential energy - the corresponding function was introduced just to somehow name the result of the
implicit integration of a vector function describing the force field.
Echoes of mid-XIX century discussions, whose participants - from different positions - tried to give
an interpretation of elegant mathematical constructions leading to formulas, later interpreted as an
expression of conservation laws, can also be traced in philosophical literature - it is enough to recall
Anti-Dühring of F. Engels. It is appropriate to recall these discussions here for a very definite reason -
the concept of “energy” in its modern form was born from mathematical calculations and only then
received a physical and philosophical interpretation. It penetrated into mass consciousness much later -
somewhere at the turn of XIX and XX centuries.
Consequently, there is every reason to raise the question of building a theory, which will include
information that has the ability to act - parallels with the early ideas about “living force” and “kinetic
energy” can be seen quite clearly.
Apparently, such considerations in the foreseeable future will form the basis for a quantitative
description of the behavior of non-trivial information structures generated by complex systems, which,
among other things, have an increasingly pronounced effect on human society.
The principle of dialectic symmetry can be applied not only to clarify the issue of “information
energy”. From it, in particular, directly implies the existence of what above was called non-trivial
information entities. Refer to Table 2.

| TABLE 2: THE HIERARCHY OF LEVELS OF ORGANIZATION OF MATTER AND INFORMATION. |
|---------------------------------------------------------------|
| **Levels of organization of matter** | **Levels of organization of information** |
| Inorganic level | Inalienable information, information alienated as a result of physico-chemical interactions |
| Sub Levels: |  |
| - microworld: submicro-elementary - |  |
| microelementary - nuclear - atomic - molecular levels |  |
| - macroworld: macroscopic bodies |  |
| - megaworld: planets - star-planetary complexes - galaxies - metagalaxies |  |
| Biological level | Relatively isolated information with its own behavior, self-organizing information |
| Sub Levels: |  |
| - level of biological macromolecules |  |
| - cell level |  |
| - microorganism level |  |
| - level of organs and tissues |  |
| - level of the organism as a whole |  |
| - population level |  |
| Social level | Information that is aware of itself, the essence of the highest information of different nature |
|-------------|------------------------------------------------------------------------------------------------|
| Sub Levels: |                                                                                              |
| - level of individuals |                                                                                          |
| - family level          |                                                                                          |
| - level of teams         |                                                                                          |
| - level of social groups |                                                                                         |
| - level of nationalities and nations |                                                |
| - the level of states and systems of states (civilizations) |                                          |
| - universal (noosphere) level |                                                                                         |

This table is designed to emphasize the following circumstance. Just as a matter can appear in the most diverse manifestations, so information cannot be regarded as homogeneous (in particular, there is not and cannot be a complete understanding of information relating to all its manifestations). From the principle of dialectic symmetry it follows unambiguously that just as there are hierarchical levels corresponding to the dialectical category of matter, so there are levels corresponding to the category of information.

In particular, we are talking about non-trivial informational entities arising and developing in the communication space, mentioned above. The term “public consciousness” is still widely used in the post-Soviet humanitarian literature. The interpretation of this term, available in philosophical dictionaries and reference books, is de facto completely built on denials or is a tautology, or expresses the concepts in question through other, conceived less clear. One of them sounds, for example, so the public consciousness is “a display in the spiritual activity of people of interests, representations of various social groups, classes, nations, society as a whole” [11]. As noted in [12], the application of such a definition is somewhat difficult due to the vagueness of the concept of “spiritual activity”.

In M. Mamardashvili we find the following definition. Social consciousness is a reflection of social being; set of collective representations inherent in a particular era. It reflects in essence the very state of a particular society. Public consciousness is opposed to individual consciousness as something in common, which is contained in the consciousness of each person as a member of society. [13].

The key in the above and similar definitions is the fact that the social consciousness (no matter what this terms means) cannot be reduced to a set of individual consciousness, that is - something else. However, such statements do not allow in the slightest degree to reveal the nature of this entity. A step in this direction was made in the monograph [14], where the neural network model of the noosphere was proposed. Within the framework of this model, the society was considered as an analogue of a neural network, and individual neurons were assigned to individuals, and interpersonal communications - connections between neurons of the network.

This analogy suggests that the informational entity, called the public consciousness, actually has a very complex structure [15]. This follows from the fact that it is generated by an extensive communication system, a very complex architecture. Moreover, there is every reason to assert that the public consciousness is formed by a combination of different informational entities, the specifics of which are determined by the characteristics of the generating communications. So, generic and family-clan ties generate informational entities of one type, professional communications - of another one, etc.

We will show it. Let us push aside the simplified model of the functioning of the brain. According to modern concepts, human intelligence and human consciousness are formed as a result of the fact that the neurons of the cerebral cortex exchange signals with each other, causing a change in the state of the neuron. These ideas were incorporated into the theory of neural networks, which are widely used nowadays for various applied purposes [16]. Moreover, it is necessary to emphasize that the theory of neural networks was initially created as an attempt to uncover the mechanisms of brain functioning, i.e. those mechanisms that lead to the emergence of intelligence and consciousness.
However, in the theory of neural networks, a number of very significant results have been obtained that are directly related to the problem under consideration. This information is distributed. The nature of the functioning of the human brain does not exist in the form of separate “memory cells”. The information is recorded by the system as a whole [17]; the neural network often has the ability to reproduce a hologram, which is the same image fragment as the original hologram, but only with degraded quality. This circumstance is more than important, since it allows one to proceed to the consideration of the global communication environment from the point of view of the mechanism of functioning of the human brain.

Indeed, any communication between individuals is actually an exchange of signals between the neurons of the brain of each of them. If two people enter into a dialogue, it is customary to say that two individuals communicate with each other. In reality, this is nothing more than an approximation. In fact, we are talking about the exchange of signals between two (or several) fragments of a common neural network, each of which is localized within the brain of each of the interlocutors. Continuing this logic, one can come to the conclusion about the existence of a global neural network. In [14], where it was first proposed to consider society from the point of view of analogy with neural networks, such a network was identified with the noosphere as a whole.

It must be emphasized here that the transition of a neuron from one state to another is in no way connected with the nature of the signals that they exchange. This shows, for example, the simplest consideration of how a person’s brain reacts to signals coming through the retina. In other words, the fact that neural network fragments exchanging signals are localized within the brain of different individuals does not affect the fact that, in aggregate, these neurons form some kind of common network.

Since the information stored by the neural network is distributed, it should be concluded that there is a very definite amount of information that is only indirectly associated with the memory of individuals, but correlates with the global neural network as a whole. This conclusion allows us to interpret such concepts as a socio-cultural code, mentality and social consciousness from purely natural-science positions, more precisely from the positions of information theory.

It is worth emphasizing that, until recently, the processes occurring in the global communication network remained practically inaccessible neither for influence, nor even for sequential study. To illustrate, it suffices to mention the following fact. Until now, one of the main methods of studying the processes occurring in society is a sociological survey. Such means, firstly, are extremely costly, and secondly, during sociological surveys, the coverage of the respondents is relatively low. The use of social online networks for similar purposes (Facebook, etc.) makes it possible to significantly expand the initial base available for direct observation.

We emphasize that the global communication environment relates to a different level of the organization of existence, rather than individuals. It is extremely difficult for an individual person to understand and comprehend the processes occurring in the global communication environment, just as it is difficult to imagine a person entering into dialogue with a single neuron from the cortex of his own brain.

The gap between these levels of the organization of things can be overcome precisely by using artificial intelligence systems, which, on the one hand, are able to process very large amounts of information, and, on the other hand, they are able to directly connect to the global telecommunications environment.

Thus, the interpretation of concepts, one way or another connected with ideas about sociocultural codes, can indeed be given on the basis of analogies with neural networks. It also creates prerequisites for the quantitative description of identities as certain information objects recorded in the global communication network - the noosphere.

Any of the scientific and technical paradigms can be considered as one of the entities that remain and develop in the public consciousness. According to T. Kuhn [17], the scientific paradigm is a set of scientific achievements recognized by the scientific community in a given period of time and serving as the basis and model for new scientific research. Essentially, Thomas Kuhn said that a separate theory or a separate scientific achievement cannot master one’s mind so much as to fully set the development vector of a particular branch of knowledge; only a certain set of such theories can do this.
One of them can be refuted or modified, but in general, the structure of knowledge remains essentially the same, and accordingly the vector, which sets the direction of development, is not altered.

Exaggerating somewhat, we can say that the scientific paradigm is the basis of that ideology (more correctly to speak about the system of scientific views), which is shared by the overwhelming majority of scientists working in this field and which is officially codified with texts (theories, etc.) recognized in science as classical or canonical.

Therefore, the paradigm - that is what makes the scientific belief system (with all their variegation and diversity), some single entity; it also forms a well-defined conceptual apparatus, a certain discourse, which allows members of the scientific community to feel themselves as one, opposing themselves to others.

All this together creates a certain scientific tradition, as well as formal and informal institutions that are complementary to it (the latter include, among other things, the various unwritten rules that most scientists adhere to).

Let’s pay attention to the following circumstance: the scientific paradigm exists and develops in many respects like a living organism; some of its carriers (specific scientists) leave this world (as individual cells of a biological organism can die), but the informational entity under consideration as a whole continues to exist.

Moreover, the paradigm as such is only indirectly related to the memory of an individual scientist; rather, its existence should be correlated with collective memory, more precisely with that fragment of the global communication environment that is associated with scientific research and development. There is also no doubt that the scientific paradigm is an object of a purely informational nature, and having a pronounced own behavior. The argument in favor of considering the paradigm as a special information entity with its own behavior is that the corresponding information is distributed, and here the analogy with the neural network is quite appropriate. The loss of a separate part of the communication network does not affect its functioning as a whole.

There is no doubt that in modern conditions the development of informational entities generated by communications in society undergoes pronounced transformations, which, first of all, is due to the development of telecommunication technologies. In this regard, many authors, for example [18],[19], speak about the formation of a new media realism. It is worth emphasizing that the parameters characterizing communications in society are subject to well-defined regularities, which are already revealed at this stage of research [20],[21]. In the quoted work it was shown that the distribution of users according to the number of friends in social online networks is described by a very specific formula, and one of its parameters retains a constant value for all cities, without exception, for which data was collected. This testifies in favor of the conclusion that the processes of self-organization in the communication space do not simply obey certain laws, but proceed in much the same way in different cities.

3. Conclusion
This implies the following most important circumstance of direct practical importance. Higher education in modern conditions does not de facto deal with individuals, as it was in the days of Jan Amos Comenius. It interacts with non-trivial informational entities, whose behavior, in particular, determines how effective the training will be. Simplifying, the student will easily learn the provisions that are fixed by the surrounding communication environment, while the assimilation of information that does not fall into this category will be extremely difficult. They will be de facto rejected as “irrelevant”, “uninteresting” or “not related to everyday life”. The misunderstanding of this circumstance, the attempt to overcome the numerous crisis phenomena in modern higher education within the framework of a paradigm that goes back to Comenius, only exacerbates negative trends. Moreover, such a state of affairs creates a real threat to the intellectual sovereignty of Kazakhstan and other states of the Eurasian Economic Community [16].

Considerations of this kind suggest that the methodological elaboration of issues one way or another connected with the concept of “intellect” is also important from the point of view of overcoming the crisis phenomena inherent in modern higher education. Modernization of higher education requires the transformation of basic approaches to the organization of higher education,
complementary to the significant changes taking place in modern society. This, in turn, requires an adequate interpretation of the entire system of concepts, one way or another connected with the “information” category. The formulation of the principle of dialectic symmetry proposed in this work allows us to do this, overcoming the many contradictions that abounded in the previously proposed interpretations of the concept “information” and “intellect” (broader, social, collective consciousness).

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