Interpretation of the category of “complex” in terms of dialectical positivism

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Abstract. The interpretation of the category of complex is given on the basis of dialectical positivism, in the framework of which the principle of dialectic symmetry is formulated. It, in turn, is based on the consideration of matter and information as paired dialectic categories. In accordance with this principle, information objects form a hierarchy similar to that which corresponds to different levels of matter organization (mechanical, chemical, biological, social). As “complex”, one should interpret the system that is the medium for the information object at least one level higher than the level related to trivial information (that is, one that is inextricably linked with the object itself). This level is the level corresponding to estranged information (simplifying information about a certain object recorded on another medium).

1. Introduction

Human civilization is currently dealing with increasingly complex systems. This, to put it mildly, actualizes the analysis of the concept of "complex", or rather, the analysis of the category of "complex", understood in the philosophical meaning of this term. It would not be an exaggeration to say that science, once created during the Enlightenment, was an answer to the challenges that civilization faced on the part of the forces of nature. However, in its development, civilization has generated numerous new challenges, and all of them are somehow connected with the appearance of more and more complex systems created by man himself.

The largest thinkers of the 20th century have repeatedly made attempts to understand the nature of the complex as such. Here, one cannot fail to emphasize the systematic approach of von Bertalanffy, the ideas of Ilya Prigozhin and much more. In modern literature, numerous systems are also analyzed that satisfy, in one sense or another, the criterion of “complexity”, in particular, [1-4]. These and other works clearly demonstrate that very often when considering "complex" systems, the nature of their constituent elements becomes secondary. The structure of relations between the elements of the system comes to the fore.

Moreover, many of the works performed in the same vein as those cited above, for example, [5,6], consider extremely abstract complex systems in which elements are structureless, and their only property is the ability to form certain connections with other elements of the system. All these works are certainly more than serious interest, and the results obtained in them already allow us to raise the question of the corresponding generalizations of the philosophical level.
In this paper, on the basis of the philosophy of dialectical positivism [7-9], an attempt is made to prove that the nature of the complex is purely informational. In other words, a system becomes complex when the processes of exchanging information between its components under the systems come to the fore, more precisely, a complex system cannot but be a system for processing information, albeit of the simplest type.

We emphasize that it is precisely this view of the nature of complex that is also being updated in connection with the problems of artificial intelligence. Indeed, any form of human intellectual activity is somehow related to the existence of a very specific complex system - the brain, and they appear as a result of the exchange of signals between relatively simple elements - neurons. Each individual neuron that is part of the brain is able to perform only relatively simple functions. However, together they give rise to some new quality - human consciousness, mind, intellect and so on.

This example can be generalized. Namely, we argue that the exchange of information between relatively simple elements of the system under certain conditions can give rise to a new quality, that is, some information objects that have relative independence, just as the exchange of information between brain neurons generates consciousness. This is the most obvious example of an informational object with relative independence. Consciousness depends on the functioning of all neurons of the brain in the aggregate, but very weakly depends on each of them individually. At a minimum, this is a system property.

Another example of a relatively independent information object is any particular science - its carrier is the entire scientific community as a whole, this information object is preserved even when individual scientists pass away. Moreover, modern science of science claims [10] that very often specific scientific areas develop, subject to their own logic of development, i.e. the degree of independence of this object from system elements (individual researchers) is much greater than it might seem at first glance.

An example of the human brain in this regard, of course, is partly debatable. Namely, it is clear in advance that brain neurons are a system designed to process signals. It is not obvious that elements of complex systems of a different nature can also be considered in terms of information processing processes. Based on this, it is not obvious that this example can be generalized to complex systems of arbitrary nature.

However, for all the debatability, this example nevertheless unequivocally shows that in a complex system (at least of a certain type), under certain conditions, a new quality may appear - a relatively independent information object, only indirectly associated with the elements that make up the system.

This is a new quality that does not appear due to the fact that elements have certain properties, but because they have the ability to form relationships with each other. There are conditions when the nature of the relationship between the elements of the system undergoes a qualitatively-quantitative transition (this term is used in the sense that classical dialectics give it), as a result of which something new is born in the system - an object that cannot have any other nature than information. In any case, its consistent analysis can be carried out in terms of information theory, since the properties of the elements themselves that make up the system remain unchanged.

It is in this sense that in this work any systems that satisfy the criterion of complexity are treated. A new - informational - quality appears in them.

The proof of the statements made is given in this paper from the standpoint of dialectical positivism [7-9]. Examples related to the field of specific sciences are purely illustrative.

2. Informational nature of the complex: justification based on the principle of dialectical symmetry

In accordance with the point of view of dialectical positivism [7-9], information should be considered as a dialectical category, a paired category of matter. As you know, objective dialectics defines the basic concepts called categories through opposition. It is impossible to give them the usual definition, understood in the "school" sense of the word precisely because they are the most fundamental, and an attempt to reveal the meaning of these terms through others inevitably leads to a vicious logical circle.

Once such a definition of the category of information is given, the next step can be taken immediately. Namely, there is a well-defined hierarchy of levels of organization of matter; there is a level associated with the mechanical movement, then with the chemical, biological and, finally, social. (All these levels of organization of matter, of course, have sublevels.)

The principle of dialectic symmetry [9], starting from the above definition of information given by the philosophy of dialectical positivism, argues that a similar hierarchy exists in relation to all those entities that are associated with the category of information.

To simplify somewhat, we can say this: a hierarchy of levels of organization exists in the "material world", and accordingly a similar hierarchy must exist in the "information world", which directly follows from the law of unity and struggle of Hegel's opposites. Of course, the concepts of “material world” and
“information world” in the statement stated above should be understood rather metaphorically, since “material” and “information” are inextricably linked with each other.

Consider a hierarchy of information objects. The simplest form of information is that associated with individual messages. This is, for example, a binary number record or a record made by the letters of another alphabet. At the next level of the hierarchy of information entities are information objects, which are the rules for operating with information of the simplest type, in particular, the rules for operating with binary numbers.

Indeed, the arithmetic rules of addition, multiplication, etc. it is also information, but it is information of a special type. It allows you to work with other information objects (in particular, add binary numbers) and thereby obtain additional information (the result of addition, for example).

At an even higher level are information objects that acquire relative independence in relation to their medium. An example is mathematics in general. This is a well-defined information object that is capable of developing within the framework of its own logic.

Yes, of course, this development is carried out by mathematicians, but the result of their collective efforts is not connected with any of the mathematicians individually, it is connected with the entire mathematical community as a whole and develops, subject to its own laws. It would not be an exaggeration to say that mathematics as an information object is registered in the noosphere (understood in the sense that V.I. Vernadsky attached to this term [10]) as a whole. Simplifying somewhat - mathematics is much more than the sum of knowledge that each mathematician has individually.

Let us return to the hierarchy of information objects.

Obviously, here it is necessary to distinguish some lower level of the hierarchy, which separates just information (for example, messages) from more complex information objects. From the point of view of dialectical positivism, this level is associated with objects capable of, at a minimum, capturing certain information. The recorded information is the simplest information object that allows you to interpret the category of complex from the proposed point of view. Let us explain the above with an example.

Each of us is witnessing a wide variety of events. For example, it may simply be that a passenger forgot a book in the subway or made some other minor action. It is obvious that in such events, as in any others: the material and informational aspects are dialectically inextricably linked with each other. By studying individual water samples, one can obtain the necessary information about the physical and chemical properties of water in general.

Returning to the example of insignificant events, we can say this: this event either goes unnoticed, or someone fixes it in his memory (or writes it in a diary), or carries out some other actions, as a result of which this information can be replicated further.

Considerations of this kind lead to ideas about alienated information [8.9]. The fact of recording information about an event indicates that the information is alienated here. Likewise, the scientific knowledge obtained in the study of samples of a chemical substance also leads to the fact that information is alienated from the original objects. In a certain sense, the dialectical unity between the matter of information, originally inherent in these objects themselves, is being destroyed.

So, fixing information, transferring it to another medium also corresponds to the lowest level in the hierarchy of information objects.

At the next level of the hierarchy are information objects that form certain information processing systems. So, the rules for operating with binary or decimal numbers also represent information (it can be fixed, for example, recorded in a textbook). But, this information is something qualitatively different in comparison with a “simple” message - the rules for operating with binary or decimal numbers allow you to receive new information, for example, to calculate the characteristics of a non-existing electronic circuit.

At an even higher level of the proposed hierarchy are information objects, which are information processing systems capable of generating other information processing systems related to a lower hierarchical level. An example of such an object is geometry as a whole; it is a means of obtaining theorems that can themselves be used to generate new information (for example, when performing calculations). Continuing this logic, we can come to the following interpretation of the concept of intelligence; it is such an information processing system that is capable of generating information processing systems of such a high level that they allow us to make judgments about the original system. In the language of the humanities, this means - such a system is able to recognize itself.

Thus, the principle of dialectical symmetry allows you to enter into use a certain hierarchy of information objects, and accordingly - a hierarchy of systems of an arbitrary nature in terms of “complexity”. Any information object is dialectically connected with its carrier; therefore, by a “complex”
system of a certain hierarchy level, one can understand that which is a carrier for an information object of a corresponding complexity level.

As a "complex" system (without additional refinements), it is therefore logical to interpret one that is capable of generating information objects, at least one level higher than the minimum. Therefore, these are systems in which processes of alienation of information can take place.

It is appropriate to emphasize here that there are a huge number of complex systems in which we can talk about the alienation of information. For example, in the chemistry of macromolecular compounds, the so-called customizable sorbents are widely known [11]. The configuration of the polymer is selected so that it selectively captures the atoms or molecules of a certain substance, which also have the corresponding geometric characteristics. Obviously, a customizable sorbent can also be interpreted from an information point of view. This is a connection that stores information about another connection. Biological informational macromolecules - RNAs - perform similar functions, but obviously related to a higher level of "complexity" in the above sense. This example can be generalized. In particular, returning to the works cited above, in which complex systems of various nature (as well as systems formed by abstract "elements") were studied, it can be noted that many of them are characterized by so-called "phase transitions" - the system jumps from one state to another. Moreover, as shown, for example, in [12], this transition is often accompanied by hysteresis phenomena.

Obviously, if we are talking about a complex system, then it is always possible to identify well-defined local fragments in it, and, therefore, any distributed complex system, some parts of which can undergo a phase transition relatively independently of others, can be considered as an analogue of a neural network [13].

Indeed, any relatively independent fragment of such a system can be associated with a neuron. The absence of a phase transition is treated as a logical zero, the fact of a phase transition is treated as a logical unit. As long as the system is still a whole, the phase transitions in individual parts of the system will inevitably affect at least the neighboring ones (Fig. 1). In accordance with the scheme shown in this figure, a complex system is conditionally divided into regions, in each of which a phase transition occurs. Arrows indicate the effect of regions on each other. In other words, a feedback system arises here, and the system as a whole can be considered as an analog of the Hopfield neuroprocessor (Fig. 2). An example of a specific system in which nontrivial phase transitions corresponding to the model of Fig. 1 are realized is considered in [14].

![Figure 1](image1.png)

**Figure 1.** Inhomogeneous system in which phase transitions take place, as an analog of a neural network

![Figure 2](image2.png)

**Figure 2.** Schematic of the Hopfield neuroprocessor
Accordingly, any external influence on such a system can be considered in the language of information theory: what leads to phase transitions can be described in terms of logical units and zeros (which becomes especially clear when the phase transition leads to the appearance of inhomogeneities).

This example also allows generalization. Namely, it shows that a system that has crossed a certain threshold of complexity, at a minimum, can be considered as something where information reading processes take place. Moreover, since there is a certain interaction between the parts of the system, we can say that the system of the considered level of complexity provides the reading of information from one part with the help of another. If this condition is met, then an information object of the lowest hierarchy level, which was mentioned above, is obviously formed in it. Moreover, this is a prerequisite for the formation of information objects related to higher levels of the hierarchy.

3. Conclusion

Thus, the principle of dialectical symmetry allows us to give the following interpretation of the category of “complex”. A system is treated as complex when information objects are formed in it that lie at least one level higher than trivial (inalienable information), or prerequisites are created for the appearance of such objects.

The lowest level in the hierarchy of complex systems is occupied by those that provide alienation (reading information), i.e. By studying them, one can obtain information not only about these systems themselves, but also about some others.

At higher levels of the hierarchy of complex systems are systems that are carriers for information processing systems.

4. References

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