# BASIC MESO-MODEL OF THE PROCESS OF ARTIFICIAL GENERATION OF NEW KNOWLEDGE OUTSIDE THE HUMAN BRAIN

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## Abstract

The task of artificial generation of new knowledge outside the human brain. as an intellectual task of the highest level, in principle can be solved provided that its solution includes not only the informational, but also the truth component. However, it is possible to model truth to the same extent as we can model human feelings. In this formulation, the solution to the problem is considered as option number one. But whether it is possible to implement it using neural networks is a question that does not yet have a clear answer. However, there is also option number two, when artificial thinking systems for generating new knowledge (and this has been proven in practice) do not create truth from scratch, but use time-tested true knowledge accumulated by humanity. For this, a special repository of meanings is formed (the so-called semantic thesaurus), and then truly new knowledge is created on their basis. This option is an alternative to the first option. The article discusses possible ways to solve such problems.

Keywords: Semantic core, truth, new knowledge, artificial thinking, neural network, human brain

## **1. Introduction**

The choice of research paths was prompted by the so-called paradox of H.Moravec [1]: mental activity of the highest level, characteristic only of a fully intellectually formed person at the highest stage of ontogenesis and manifested in solving logical problems, conceptual thinking, intellectual games, engineering calculations – in short, in everything that needs special training and development – is much easier to be algorithmized and programmed than functions that develop early and almost spontaneously, are accessible to us from childhood and bring humans closer to other mammals.

In accordance with H. Moravek's paradox, the task of generating new knowledge unexpectedly turned out to be the "easiest and simplest" task for modeling. To solve it, let's consider the structure of the human brain, which can be conventionally represented as a three-level model.

The macro-level is primarily an area of manifestation of a person's higher mental activity. This level includes technologies and research results from such sciences as psychology, psychiatry, sociology, etc. The micro-level is a neural structure or an element base that has also been studied in great detail and qualitatively, and many world–class discoveries have been made here. All systems called artificial intelligence have been created based on models of neurons connected in a network. In the near future, it is expected to use models with the maximum number of types of neurons (there are more than 50 of them), as well as other (chemical) types of interaction found in large quantities in the interneuronal space [7].

As follows, from the standpoint of the necessary systemic completeness, in addition to the macro and micro levels, it is necessary to additionally introduce another logically missing level - the meso level, which occupies an intermediate position between the macro and micro levels.

The meso-level provides a continuous, unambiguous functional connection between brain neurons and mental activity and is essentially their "place of function transformation." That is, the meso-level is the product of the interaction of micro- and macro-levels. But the most important thing is that the meso-level should be a physical place of localization of new knowledge (NK). Because NK must be localized somewhere in the structure of the brain. It is also logical to assume that the NK is not only located at the meso-level, but is also formed at this level.

In the processes of thinking, such a category as the truth of knowledge plays an extremely important role. Intuitively, we tend to view truth as something opposite to uncertainty, as its antipode. Unfortunately, truth is not often considered as an object of mathematical modeling, as it is unclear how to measure it.

However, the procedure for measuring the truth of knowledge can be implemented based on a semantic approach if it is related to the number of arguments that confirm the truth of this knowledge. And on this set of arguments,

you can set some function that will carry the meaning of the truth of knowledge. This approach is justified by the fact that this is how, or almost how, the human thinking system functions.

Thus, it turns out that the solution to the problem of the formation of NK at the meso-level is reduced to the technology of creating a certain basic model, where a kind of synergetic convolution of two categories takes place - information and truth.

If this option is implemented, then scientific theories about the structure and functions of neurons and neural networks should become part of a more general theory of the formation of neural structures not only as information models, but also as models of human feelings [4]. In other words, models of intracerebral neural networks should have a cognitive "superstructure" in the form of models of feelings. And only after that will we be able to claim the creation of a full-fledged "human-like" artificial thinking system capable of generating NK.

It is known that all neural networks use mainly the classical neuron model. However, neural networks have a serious drawback – their training requires huge resources, amounting to tens and hundreds of thousands of data. Therefore, the question arises: is this amount too excessive? After all, in real life, a child does not need to repeat the same skills and knowledge thousands of times so that he learns them well, and a chicken remembers information about poor-quality grain the first time.

## 2. The Method of Solving the Problem - Truth Postulates

First of all, what is truth? Truth is a collective concept that includes the following components: plausibility + conviction + evidence + authenticity + objectivity + reliability + reliability + verification + confidence + persuasiveness + correctness + certainty + accuracy + reality + trust + verifiability + consistency + confirmability +......[4].

The main difficulty of generating an NK is to prove its truth. But the proof is not in the mathematical sense, but exactly the way the brain does it. In order to understand this technology of proving the truth of NK by the brain, it is necessary to relate the properties of truth to the structure and functions of the brain. The properties of truth and their relationship to brain functions can be formulated in the form of the following interrelated postulates.

Postulate 1. Let us formulate a definition of the truth of the NK using the considerations listed above.

Truth is a set of subjective feelings of the reality of the existence of the studied object of knowledge, including components:

• correspondence (adequacy) of new knowledge to an object according to Aristotle,

• semantic consistency in the presence of a metalanguage according to A. Tarsky,

• a systemic relationship with already true knowledge,

• the general acceptance of new knowledge.

Postulate 2. Without a sense of truth, knowledge is information.

Knowledge = information about the object + a sense of the truth of the subject.

*Postulate 3*. From the point of view of truth, the process of forming managerial decisions (under the influence of uncertainty factors) is considered as an equivalent process of generating NK.

Postulate 4. The truth of NK is contained in the metalanguage.

*Postulate 5.* The brain implements both processes of generating information about an object and proving its truth using the right and left hemispheres. Each hemisphere strives for its own understanding of truth, and then both of them strive to achieve a "common denominator" between them.

*Postulate 6.* The process of generating NK begins in the right hemisphere and represents the unity of two simultaneous parallel processes:

- 1. the intuitive formation of a certain conclusion about the object under study (i.e., the formulation of the NK itself)
- 2. and the intuitive formation of a sense of the absolute truth of this conclusion.

Postulate 7. The truth of the whole is less than the sum of the truths of its parts/

*Postulate 8*. The thought process always carries with it a tendency to increase the amount of knowledge used with little truth.

*Postulate 9.* Ensuring the truth of a new law is implemented by using the procedure of semantic analysis of this new law.

*Postulate 10.* Any conclusion, any thought, at the moment of generation by the brain automatically becomes and is perceived only as true, regardless of their correctness, logic, correctness or even their possible absurdity.

Postulate 11. The feeling of the truth of NK can be equated to an innate instinct.

Let's turn to the world-famous methods of proving by criteria of truth. There are several of them: truth according to A. Tarski, truth according to Aristotle, conventional truth, coherent truth. Figure 1 shows these criteria and their relationship to the object under study. Let us assume that the truth of the NK, as a certain statement, is ensured by the recursion method due to the truth of those terms that make up this statement.



Fig. 1. The criteria of truth and their relationship with the studied object

#### 3. Problem Solving

If the formation of a new law in the form of a procedure for assembling terms into a complete and meaningful phrase occurs without much difficulty (except for the process of enlightenment), then the proof of its truth accounts for the bulk of all related 'New law efforts'.

Let's call these true terms the arguments for the truth of the formed NK.

If we follow the universal principle of maximum entropy (in Fig.1 this is the truth according to A.Tarski), then the problem of forming the structure of a true NK on a set of true arguments can be formulated as follows:

From the given true state structure NK is committed to move to another true state, where some level of resource consumption, total entropy of truth tends to a maximum, and in General form is written as a formal equality [3]:

$$H = -\int_{\Omega} f(x) \ln f(x) dx = max, \tag{1}$$

if there are limitations:

$$\int_{\Omega} E(x)f(x)dx = E,$$

$$\int_{\Omega} f(x)dx = 1,$$
(2)

where x is the number of true arguments, defined on the set  $\Omega$ ,

f(x) is the frequency distribution of the truth of NK on the set of true arguments of x;

H is the entropy of the distribution of true arguments;

E(x) is the resource spent on generating the truth of x arguments.;

*E* is a shared system resource.

The solution to the problem boils down to the following: the truth of an NK satisfies the condition of its maximum entropy (1) under resource constraints (2), which ultimately boils down to the formula [5]:

$$H(Q) = 4.59 Q^{-3.59},\tag{3}$$

where Q is the number of true arguments that ensure the maximum truth of the statement being proved.

Note that the entropy of a system containing N elements increases logarithmically

$$H(N) = Ln(N) \tag{4}$$

If we compare the rate of increase of H(N) = Ln(N) with the rate of decrease of  $H(Q) = 4.59 * Q^{-3.59}$ , then we will see that the rate of decrease of H(Q) is much higher than the rate of growth of H(N), which indicates that the human thinking system for establishing truth is sufficient it "handles" large amounts of data well.

However, most likely this cannot be said about animals, for which this dependence, if it occurs, has the opposite tendency. That is, animals are not able to establish the truth for complex objects.

Thus, the entropy of truth depends on a single parameter Q – the number of true arguments underlying its proof. Moreover, if the value of the classical entropy of a system increases with an increase in the number of elements included in this system, then the opposite is true here – the more arguments, the lower the entropy of truth. This is quite logical.

Let us introduce the concept of the semantic truth core (STC) of a term as the minimum number of arguments Q, providing an unambiguous understanding of it for the maximum number of people. Semantic truth cores are calculated using a specially designed program. Then a digital semantic thesaurus (DST) is a dictionary in which terms are defined using semantic truth kernels [2].

The lowest level of truth of NK corresponds to H(2) = 0.381. Further, with an increase in Q, the truth increases, while maintaining the quantum discreteness of the TCT.

Quantum level $Q$	H(Q)
2	0,381
3	0,089
4	0,032
5	0,014
6	0,07

Table 1. Values of the STC quantum levels

#### 4. Experimental Results

#### Truth in communication

On the basis of communications, it is not so much the information itself that is formed and transmitted, but rather the meaning of this information, i.e. the truth.

Conclusion: statements with a lower Q value are more susceptible to deformation than those with a higher Q value, and vice versa.

This is of fundamental importance in communication processes. Therefore, it is advisable to know in advance the meaning of the terms used, so that these terms and statements based on them can be used in negotiations and other situations where you need to defend your position.



Fig. 2. The place of the DST in communication between the human society and the society of robots

The DST is essentially a thesaurus of semantic kernels of the truth of terms. The purpose of the DST is to create a single universal language not only for human-to-human communication, but also for human-to-robot, as well as robot-to-robot, i.e. robots will be able to communicate with each other in human language.

Here, the problem of the safety of using robots can also be solved at the semantic level.

Below, table 2 shows a fragment of the DST obtained as a result of applying the described method [6]. It can be seen from the above table that semantic kernels exist for terms with a value of Q>1. If Q=1, then there is no semantic core. Such a term, for example, is "information". The lack of a semantic core in the term "information" is explained by the fact that this term has too general and ambiguous interpretation of its meaning. If the term has a semantic core, then this indicates its unambiguous understanding by different people.

The greater the value of Q, the clearer the understanding of the term. And with a sufficiently large Q >> 1, the term is understood quite unambiguously. This is especially noticeable for mathematical, medical, and other professional and specific terms.

Table 2. An example of a DST fragment in the form of terms and their STC

The term	Semantic truth core	Q
Artificial	A computer with human thinking	3
Intelligence		
A system	A set of interacting elements of a whole	4
Understanding	Comprehension of the meaning of meaning	3
Consciousness	The mental activity of reflecting reality	4
Thinking	The mental activity of reflecting and cognizing reality	5
Information	There is no SCT (semantic primitive)	1
An element	An integral part of a whole	3
The machine	A mechanism for energy conversion	3
Science	The activity of developing objective knowledge about the world	5
The derivative	The limit of the ratio of the increment of a function to the increment of an argument tending to zero	8

From Fig. 3 it is evident that a higher value of Q corresponds to more true (or more "mathematized")knowledge. Consequently, NK tends precisely in this direction.

From the terms compiled in this way, it is possible to generate NK as statements. And after this follows the stage of checking the statement for truth according to the criteria specified above [4]. If all four criteria of truth are satisfied, then the statement is recognized as true, and otherwise it is necessary to improve and supplement the system of evidence. This is how the brain evaluates truth.



Fig. 3. Scale of truth value and arrangement of non-continuous terms

#### 5. Conclusion

The technology of assessing the truth of statements in the paradigm of generating NC can be presented and accepted as a basic meso-model of brain function.

#### Advantages of the model:

- 1. it is quite simple, understandable, has prospects for further development,
- 2. has access to linguistic, optimization and other classes of models, which indicates its universality.

3. it is convenient in that it allows you to find the "place of transformation of functions" at and be an indicator of deviations from this point.

## References

- 1. Hans Moravec. Mind Children: Harvard University Press. P. 15. 224 p. ISBN 978-0674576186.
- 2. Golubev S. S., Gubin A. M., Ivanus A. I., Romanenko N. Yu., Shcherbakov A.G. Problems of creating a semantic thesaurus as a repository of meanings. Innovations and Investments. No. 12. 2023. p. 326-330.
- 3. Zalichev N.N. Entropy of information and the essence of life. Moscow: Radio Electronics, 1995.192 p.
- Ivanus A.I. Artificial generation of new knowledge: modeling of thought processes to obtain new knowledge outside the human brain. A qualitative leap in the development of artificial intelligence (study guide). - M: LENAND. 2022. 200 p. (Science of the Artificial. No. 45).
- Ivanus AI On the artificial generation of new knowledge. In the collection: Systems analysis in economics -2020. Proceedings of the VI International scientific and practical conference-biennale. General editors G.B. Kleiner, S.E. Shchepetova. Financial University. Moscow. 2021. pp. 168-171.
- 6. Ivanus AI, Bashelkhanov IV, Dukin TR, Golubov AI Digital generator of semantic cores of terms and definitions. Certificate of state registration of computer program No. 2024660171 dated 03.05.2024.
- 7. Sakharov D. A., Kuznetsov O. P., Dyakonova V. E., Zhilyakova L. Yu., Vorontsov D. D. Chemical languages of nervous systems. M.: YASK Publishing House, 2024. 216 p.
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