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The relationship between the concepts of intelligence and artificial intelligence

Abstract: Artificial intelligence is needed to perceive, remember, creatively process incoming information an order of magnitude better and faster than natural intelligence (or in reverse order), constantly replenish its reserves in order to make extraordinary decisions and actions in specific situations.

However, without natural intelligence, all this is impossible to do, and therefore it would be correct to say about the improvement of the prototype (its elements), and not the creation of an artificial prototype.

Key words: intelligence; artificial intelligence; understanding; mind; prefiguration; prototype.

Let us try to consider the relationship between the concepts of intelligence and artificial intelligence, since, from our point of view, this has methodological significance.

First, let us note that the antonym of the word "artificial" (man-made) is the word "natural" (authentic, organic, etc.) [10, p. 39], i.e. the basis of artificial intelligence is intelligence as a category of a number of scientific disciplines.

The concept of "intelligence," derived from the Latin "intellectus," meaning "understanding, knowledge," is at the same time a Latin translation of the ancient Greek word "νοῦς" (nous) – mind [25]. It seems that the above is the first paradox, the essence of which we will try to outline below.

In various concepts and perspectives, the concept of intelligence has been considered from the ancient world and is continuing to excite human minds even in our time. So, Plato and Aristotle considered that intelligence is the force that defines a person since the ideal, as a reflection of the universal, is the result not of contemplation but of human activity [25].

Nicholas of Cusa viewed intelligence as the highest spiritual force that penetrates to the supersensory truths and the unity of opposites [25], Spinoza considered the concepts of reason and intelligence identical [5]. Immanuel Kant understood intelligence as the highest cognitive ability that gives principles to reason [18].

In psychology, the concept of intelligence is interpreted depending on the research perspectives. So, the phenomenological approach (M. Wertheimer, W. Köhler) defines intelligence as a special form of consciousness content [9; 19], the genetic approach (W.R. Charlesworth and others) as a consequence of increasingly complex adaptation to environmental demands under natural conditions of human interaction with the external world [49], the procedural approach (K.A. Abulkhanova-Slavskaya, V.Yu. Kramarenko, S.L. Rubinshtein, O.K. Tikhomirov) as a special form of human activity [1; 23; 31; 36], the informational approach (I.S. Kostrikina, B. Goodman, J.

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Harder, R.J. Sternberg) as a set of elementary information processing processes [22; 50; 54], the regulatory approach (B.G. Ananyev, E.I. Stepanova) as self-regulation of psychic activity [4], etc.

In particular, the German psychologist W. Stern believed that intelligence is a general ability to adapt to new living conditions [43, p. 57], and in opinion of A. Staats, K. Fischer, R. Feuerstein, and others, intelligence represents a person's ability to learn, acquire new knowledge, skills, and abilities [60, p 313-339].

Swiss psychologist J. Piaget wrote: "Flexible and at the same time stable structural equilibrium of behavior – that is what intelligence is, which in essence is a system of the most vital and active operations" [28, p. 4].

According to L. Gottfredson, intelligence is a very general mental ability that includes the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, quickly learn, and learn from experience [55].

Russian scientist, M.A. Kholodnaya, relying on a structural-integrative approach, concluded that intelligence is a form of organization of individual mental experience. She believes that the criteria for the development of individual intelligence should be sought in the peculiarities of how a person perceives, understands, and explains what is happening [41, p.76].

There is a reasonable belief that that intelligence is a relatively stable structure of an individual's mental abilities, which includes acquired knowledge, experience, and the ability to further accumulate and use them in mental activity. The authors consider that the intellectual qualities of a person are determined by the scope of their interests, the volume of knowledge and therefore in a broad sense, intelligence is the mental abilities of a person, a set of all cognitive processes, and in a narrower sense – the mind, thinking. The leading components in the structure of human intelligence are thinking, memory, and the ability to behave reasonably in problem situations [32, p. 61].

The Big Psychological Dictionary edited by B.K. Meshcheryakov and V.A. Zinchenko, states that intelligence: a) is a general ability to learn and solve problems, which determines the success of any activity and lies at the basis of other abilities; b) is a system of all cognitive abilities of an individual: sensations, perceptions, memory, representation, thinking, imagination; c) is the ability to solve problems without trial and error "in the mind." The concept of intelligence as a general mental ability is applied as a generalization of behavioral characteristics associated with successful adaptation to new life tasks [8].

American psychologist J. Guilford created a structural model of intelligence, in which each factor is characterized by a combination of one of five types of mental operations: recognition and understanding of presented material; search in one direction when there is only one correct answer; search in different directions when there are several equally correct answers; assessment of the correctness or logic of a given situation; memorization and reproduction of information [7, pp. 433-456].

According to the English psychologist C. Spearman, who proposed a two-factor theory of intelligence, the factor "G" represents a special "mental energy", the differences in the level of which determine individual abilities to establish connections and relationships between elements of one's own knowledge and elements of the content of a test task. In addition to the general factor, C. Spearman included in his model a specific factor "S", which was subsequently differentiated into groups of arithmetic, mechanical and linguistic abilities [9, pp. 27-28].

According to the theory of the British-American psychologist R. Cattell, the general factor has two components: "crystallized intelligence", based on the use of the subject's existing experience,

and "fluid intelligence", which manifests itself in tasks that require adaptation to new conditions and situations, and is determined by hereditary factors. In addition to basic intellectual abilities, R. Cattell included in the structure of intelligence the ability to manipulate images when solving divergent problems (visualization factor), the ability to store and reproduce information (memory factor), and the ability to maintain a high response rate (speed factor) [31, p. 22].

This is not a complete list because there are several hundred definitions of intelligence in nature, which have fundamental differences and the list has been grown.

Nevertheless, summarizing the essence of the existing definitions, it can be conditionally stated that intelligence is most often understood as a stable set of mental (cognitive) abilities of a person, characterizing their capacity to successfully perform various types of activities by perceiving and creatively processing external information.

As for artificial intelligence, as it mentioned above it is the same intelligence, but not natural, but man-made [37, p. 188].

In the middle of the last century, leading universities around the world and various state bodies were gripped by a boom of research aimed at creating computers that functioned like the human mind. Most scientists took as their foundation the statement of English mathematician and cryptographer Alan Turing that a computer could be considered intelligent if it could make us believe that we were dealing not with a machine, but with a human [38].

Currently, there are a huge number of definitions of artificial intelligence, which also have fundamental differences, and this list is constantly expanding.

For example, according to the Oxford Dictionary edited by A. Reber, artificial intelligence is: a) an interdisciplinary scientific field that unites research and theories from cognitive psychology and computer science, focused on the development of artificial systems that demonstrate human-like thinking or intelligence; b) any artificially created intelligence, i.e., the goal of research in the scientific field [26].

In the "Practical Psychologist's Dictionary" edited by S. Yu. Golovin, it states: "Artificial intelligence: a) a conditional designation of cybernetic systems and their logical-mathematical support, designed to solve certain tasks that usually require the use of human intellectual abilities; b) the sum of the functional capabilities of an electronic computing machine - a computer - to solve tasks that previously required mandatory human participation" [14, p. 157].

The "Encyclopedic Dictionary: Psychology of Labor, Management, Engineering Psychology, and Ergonomics" notes that artificial intelligence is: a) an artificially created system performing functions that could previously be carried out only by a human or a group of people; b) a direction of scientific research at the intersection of cybernetics, psychology, philosophy, and other sciences, aimed at creating artificial intelligence systems [44].

According to "The Psychology of Consciousness" by Antti Revonsuo, artificial intelligence refers to computers and programs that replicate or exceed human intellectual and cognitive abilities [29].

In the "Great Psychological Dictionary" edited by Meshcheryakov B. and Zinchenko V., it is stated that artificial intelligence is a direction in computer technology aimed at creating computerized systems using analogs of human intellectual functions [8].

According to the "Psychological Encyclopedia" by R. Corsini and A. Auerbach, artificial intelligence is an abstract theory of human, animal, and machine cognition [21].

The Decree of the President of the Russian Federation No. 490 dated 10.10.2019, "On the Development of Artificial Intelligence in the Russian Federation," where AI is defined as a complex of technological solutions that allows imitating human cognitive functions and achieving, when performing specific tasks, results comparable to those of human intellectual activity [40].

Summarizing the above, we can state that almost all researchers define the ability of machine self-learning as an integral part of AI, and in all other cases, regardless of the amount of memory, elementary search recognition systems will take place.

However, not everything is so simple.

In 1989, British mathematician Roger Penrose published the book "The Emperor's New Mind," in which he substantiated the inconsistency of the so-called strong artificial intelligence, arguing that a certain class of problems solved by the human brain represent unsolvable arbitrary algorithms [27].

In 1996, California University professor of philosophy H. Dreyfus stated: "A digital computer is not a human. A computer has neither a body, nor emotions, nor needs. It lacks the social orientation acquired by living in society, which is what makes behavior rational. I do not want to say that computers cannot be rational. But digital computers programmed with facts and rules from our human life cannot truly become rational. Therefore, artificial intelligence in the form we imagine it is impossible" [51, p. 112-144].

In the monumental work "On Intelligence" by Sandra Blakeslee and Jeff Hawkins, it is written: "Theoretically, computers could mimic the work of the entire living brain. It is possible that one day science will reach the point of creating a computer model that mimics the work of neurons and the interactions between them. If this were indeed to happen, then human mind and artificial intelligence could be called equivalent. Although in real life such a perfect imitation of the living mind is unlikely to be possible, theoretically, it looks quite correct. The problem is that researchers engaged in creating artificial intelligence do not try to mimic its living prototype, and the programs they create, by their very nature, cannot exhibit reason. Without understanding how the living brain works, no scientist will be able to create its artificial counterpart" [7, p. 14].

On January 7, 2019, an international group of scientists from Canada, the USA, the Czech Republic, and Israel published an article titled "Learnability Can Be Undecidable" in the journal Nature Machine Intelligence. The article asserts that the existence of the unresolved Bertrand Russell paradox, Kurt Gödel's derived "Incompleteness Theorem," Georg Cantor's "Continuum Hypothesis," Roger Penrose's arguments on the impossibility of algorithmizing human thinking, among others, currently preclude the creation of AI. The scientists justified that the identification of learnability as a fundamental goal of machine learning cannot be resolved using standard mathematical axioms due to the non-existence of a dimensional quantity characterizing learnability as a whole [47].

The Russell's paradox, discovered in 1901, consists of the fact that in situations where contradictory statements about the same object have logically equal justification, their truth or falsehood cannot be substantiated within the accepted paradigm [54].

However, there is a conspiracy theory that claims the statements of Israeli scientists about the impossibility of creating AI are a diversion in the race for advanced technologies [57, p. 120-125].

Now about the essence. It can be argued that artificial intelligence is needed in order to perceive, remember, creatively process incoming information much better and faster than natural intel-

ligence (or in the reverse order), constantly replenish its reserves in order to make extraordinary decisions and actions in specific situations.

However, without natural intelligence, all this is impossible to do, and therefore it would be correct to say about the improvement of the prototype (its elements), and not the creation of an artificial prototype.

Moreover, in the case of a prototype, the problems of risks, ethical components, and much more remain unresolved.

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Соотношение понятий интеллекта и искусственного интеллекта

Аннотация: Искусственный интеллект нужен для того, чтобы на порядок лучше и быстрее чем естественный интеллект (либо в обратной последовательности), воспринимать, запоминать, творчески перерабатывать поступающую информацию, постоянно пополнять её запасы с целью принятия неординарных решений и действий в конкретных ситуациях.

Однако, без естественного интеллекта все это сделать невозможно, а потому правильно будет утверждать о совершенствовании прототипа (его элементов), а не создании искусственного прообраза.

Ключевые слова: интеллект; искусственный интеллект; понимание; ум; прообраз; прототип.

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