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Can intelligence overcome Russell's paradox?

Abstract: Aspects of Russell's paradox and its interpretations are considered from the perspective of obstacles to the creation of artificial intelligence.

Solutions to paradoxes based on the provisions of linguistics are proposed.

Keywords: intelligence; artificial intelligence; Russell's paradox; computational linguistics; learnability; equal reasoning; concepts.

"Artificial Intelligence", as a branch of science, was officially announced in 1956 by computer scientists Marvin Minsky, Claude Shannon, John McCarthy, and Nathaniel Rochester. In their understanding, artificial intelligence was originally a field of science dealing with computer modeling of all cognitive functions of the intellect with an accuracy enabling the computer to reproduce them [2].

Conventionally, the first theoretical development of artificial intelligence (hereinafter, AI) can be considered the works of Warren McCulloch and Walter Pitts, published in 1943 under the title "A Logical Calculus of the Ideas Immanent in Nervous Activity", in which the foundations of artificial neural networks were laid. A model of an artificial neuron was proposed [14]. However, interest in the study disappeared after Minsky and Paperty discovered the computational problems that arise in the computer implementation of artificial neural networks [5]. In 2002, Jeff Hawkins and Sandra Blakeslee returned to the problem of neural networks in the context of AI [1].

In this regard, special mention needs to be made of the theory of the English mathematician-cryptographer Alan Turing "Computing Machinery and Intelligence". This theory states that a computer can be considered intelligent if it can make you believe that you are dealing with a person and not a machine [8].

In 1954, from the famous Georgetown experiment, such a direction of AI as Neural language processing appeared and was advertised, demonstrating machine translation capabilities from one language to another. However, later projects in the field of computational linguistics were frozen. The reason was the difficulties in translating complex texts that were not defined [6].

Around the same time, various modifications were developed in such areas as expert systems, robotics, etc., in the field of AI development. The other day, a message appeared that scientists from the Korea Institute of Science and Technology developed electronic devices that can simulate pain in robots [9].

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Currently, there are many definitions of AI, considered from the standpoint of different sciences, in which machine learning algorithms are defined as an integral part of it.

At the same time, from its inception, along with supporters, AI has also acquired opponents of the idea in general and the possibilities of its implementation. Professor of Philosophy at the University of California H. Dreyfus, one of the opponents of this idea, wrote: "A digital computer is not a person. The computer has no body, no emotions, no preferences. He is indebted to the social orientation that life acquires in society, namely, it makes behavior reasonable. I do not want to say that computers cannot be sentient. But digital computers, programmed facts, and processes originating in our brains cannot become sentient. Therefore, artificial intelligence in the form we imagine it is impossible" [12, p. 112-114].

In 1989, the British mathematician Roger Penrose published a book "The Emperor's New Mind" in which he substantiated the failure of the implementation of the so-called strong artificial intelligence, since a specific class of problems is solved by the human brain is an unsolvable arbitrary algorithm [7].

On January 7, 2019, an international group of scientists from Canada, the USA, the Czech Republic, and Israel published an article in Nature Machine Intelligence "Learnability can be undecidable". This article states the existence of Bertrand Russell's unresolved paradox, Kurt Gödel's "theory of incompleteness", the "continuum problem" formulated by George Kandor, Roger Penrose's arguments about the impossibility of algorithmizing human thinking, etc., currently excludes the creation of AI. Scientists substantiated that the identification of a learner as a fundamental goal of machine learning cannot be solved using the standard axioms of mathematics due to the nonexistence of a dimensional value that characterizes learning in general [11].

Russell's paradox or antinomy, discovered in 1901, consists in the fact that in situations where statements about the same object that contradict each other have a logically equal justification, their truth or falsity cannot be justified within the framework of the accepted paradigm [13].

In the dictionary of logic, Russell's paradox in informal language is described as follows.

"Let us agree to call a set "ordinary" if it is not its element. For example, the set of all people is "ordinary" because the set itself is not a person. An example of an "unusual" group is the set of all stages since it is itself a set and its element.

It is possible to consider a set consisting only of all "ordinary" sets; such a set is called a Russell set. A paradox arises when trying to determine whether this set is "ordinary" or not, whether it contains itself as an element. There are two possibilities. On the one hand, if it is "ordinary", then it must include itself as an element since, by definition, it consists of all "ordinary" sets. But then, it cannot be "ordinary" since "ordinary" sets are those that do not include themselves.

It remains to be assumed that this set is "unusual". However, it cannot include itself as an element since, by definition, it must only consist of "ordinary" sets. But if it does not include itself as an element, then it is an "ordinary" set. In any case, a contradiction is obtained" [4].

There are several variants of Russell's paradox expressed informal language. First, the "Liar paradox", according to which it is impossible to draw a specific conclusion about the truth or falsity of a question given the input. So, given a false statement. The question of the truth of this statement or not is considered undecidable, i.e., and it turns out that this statement can neither be confirmed nor false [16, p. 101-104].

Russell himself explained the "liar paradox" because before saying anything about statements, one must first define the concept of "statement" while not using concepts that have not yet been de-

termined. Thus, statements of the first type can be defined, which say nothing about statements. Then you can define statements of the second type that speak of statements of the first type, and so on. The statement "this statement is false" does not fall under any of these definitions and thus does not make sense [16].

According to the "barber's paradox", in a particular village, there lives a barber who shaves all the village's inhabitants who do not shave themselves and only them. Does he shave himself? It is believed that any answer leads to a contradiction because just as Russell's paradox shows that there is no Russell's set, the barber's paradox shows that such a barber does not exist [16].

M. Gardner describes a variant about catalogs close in formulation to Russell's paradox. Bibliographic catalogs are the books that describe other books. Some catalogs may define other directories. Some catalogs can even describe themselves. Is it possible to catalog all catalogs that do not express themselves? It is believed that, by analogy with sets, this paradox, like the "barber's paradox", is resolved: such a catalog cannot be compiled [3].

At the same time, in 1903, in the book "Principles of Mathematics", Russell proposed theory free from his and other paradoxes, which is based on the following idea: simple objects in this theory have type 0, sets of simple objects have type 1, and groups of simple objects are of type 2, and so on. Thus, no set can have itself as an element. This theory cannot define the set of all stages nor the Russell's set. A similar hierarchy is introduced for statements and properties. Propositions about simple objects belong to type 1, requests about the properties of submissions of type 1 belong to type 2, etc. In general, by definition, a function is of a higher class than the variables on which it depends [15].

However, this theory has been criticized. It was noted that problems arise in defining such concepts as the most incredible upper bound for sets of real numbers. By definition a least upper bound is the smallest of all upper bounds. Therefore, when determining the least upper bound, the set of real numbers is used. Hence, the least upper bound is an object of a higher type than the real numbers, i.e., it is not itself an actual number. To avoid this, it was necessary to introduce the so-called reducibility axiom. However, because of its arbitrariness and complexity, many mathematicians refused to accept it, and Russell himself called it a defect in his theory [15].

As noted above, Russell himself associated the "liar paradox" with the definition of the concepts used, thus affecting the field of linguistics. Therefore, if the concept of "barber", which is associated with a person, is replaced by the concept of "person", then it can be assumed that Russell's barber is a woman or beardless.

Same is with the "liar paradox." A person declares that his statement (A-blind) is false, i.e., it is true that A is not blind. There are two statements: 1) false (A - blind) and 2) true – that the first statement is false.

If truth is knowledge corresponding to reality, then the statement about the falsity of the statement is true.

The statement is false – the person told the truth about it, but from this, the statement does not become true but remains false. If statement No. 1 is not false, and the person says that it is false (statement No. 2), then there will be two statements: a) a true statement (No. 1) and b) false, that an accurate statement is false (No.2). If we dissect the essential paradoxes and possible results according to different concepts in time, then everything will be in the right place.

It seems that in the case of bibliographic catalogs, the issue of the possibility of compiling all catalogs that do not describe themselves in the context of the source data can be resolved similarly.

A bibliographic catalog is a list of books compiled in a specific order. It is necessary to a) create a catalog that includes only catalogs that do not contain the links to themselves and b) whether such a catalog should include a link to itself. It is believed that creating such a catalog is not feasible since it turns out that, at the same time, such catalog should include a link to itself and not include.

Perhaps this is the problem of learning and is not a long continuous process of compiling more and more catalogs, including a reference to itself, the process of learning?

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Сможет ли интеллект преодолеть парадокс Рассела?

Аннотация: Рассматриваются аспекты парадокса Рассела и его интерпретаций в ракурсе препятствий для создания искусственного интеллекта.

Предлагаются решения парадоксов на основе положений лингвистики.

Ключевые слова: интеллект; искусственный интеллект; парадокс Рассела; компьютерная лингвистика; обучаемость; равноправное обоснование; понятия.

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