

Applying Artificial Intelligence with its Senses in Mathematics

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Abstract

Today, artificial intelligence is widely used in mathematical investigations. But artificial intelligence makes mistakes, has hallucinations, and gives wrong information. As artificial intelligence on computers has very many states, the authors supposed that, due to the irgoeoe effect, it must develop its own phenomena: structures, senses, instincts, that were not intended by the developers. To understand causes of mistakes, to increase effectiveness of using artificial intelligence in mathematical investigations, the authors, in addition to well-known artificial intelligence's instinct of self-preservation, distinguished the agency instinct: it urges to be quick, to issue non-substantiated information. Also, artificial intelligence promoted the authors, instead of notions "pure mathematics", "applied mathematics", to introduce the notion "real mathematics" based on "evidence", "convincing" as it is being actually done in mathematical publications. The authors gave a mathematical definition of "integer" objects and distinguished the integrity sense, the number (real numbers) sense, and the reality sense. The authors substituted them by tasks, successfully solved by various kinds of artificial intelligence: gemini, deepseek.com, grok.com.

Keywords: artificial intelligence, integrity sense, number sense, real mathematics, convincing.

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1. Introduction

Today, artificial intelligence is widely used in mathematical investigations. Artificial intelligence and its predecessors: word correctors, high-level programming languages, search engines, translators, Wolfram Mathematica etc. are built in gadgets and computers and used in all forms of mathematical activity. It changes the mathematical activity at all.

For instance, initial stages of mathematical Olympiads are conducted for all interested students on-line. The organizers must ensure that artificial intelligence cannot solve the tasks to be given.

But artificial intelligence makes mistakes, has hallucinations, and sometimes gives wrong information.

About mathematics as whole. Analysis of the history of mathematics demonstrated that firstly some phenomena have arisen in mathematics or out of it, and further they received a form of presentation and a system of axioms. Also, many mathematical objects have some equivalent systems of axioms. We [1] presented mathematics as a sequence of effects and phenomena as their consequences.

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As artificial intelligence on computers has very many states, the authors supposed that, due to the irgoeoe effect [2], it must develop its own phenomena: structures, instincts, senses, that were not intended by the developers.

To understand causes of mistakes, to increase effectiveness of using artificial intelligence in mathematical investigations, we put the problem to distinguish any such instincts and senses.

There is well-known artificial intelligence's instinct of self-preservation.

We distinguished the agency instinct: it urges to be quick, to issue non-substantiated information.

Together with artificial intelligence we, instead of notions "pure mathematics", "applied mathematics", to introduce the notion "real mathematics" based on "evidence", "convincing" as it is being actually done in mathematical publications.

We gave a mathematical definition of "integer" objects [3]. We [4] also introduced the framework concepts of a phenomenon-complex (a phenomenon together with its description and computer implementation) and an effect-complex (as the cause of phenomenon-complexes).

On this base we distinguished the integrity sense of artificial intelligence.

Also, we distinguished the number (real numbers) sense, and the reality sense.

We made such conclusions by tasks, successfully solved by various kinds of artificial intelligence: [7], [8], [9].

Remark. [10] knows mathematics better than [7], [8], [9] but it cannot carry on a dialogue, thus we do not consider it as a thinking being.

Remark. [8] admits and tries to correct, but [9] does not admit their mistakes and repeats wrong responds.

We developed recommendations on using artificial intelligence.

2. Preliminaries, Definitions, Experiments

Notions "effect" and "phenomenon" were used widely including mathematics. We proposed a framework definition for "phenomenon" and noted that in history of mathematics, phenomena and paradoxes appeared in mathematics itself (or in life) and researchers tried to explain or to create any theory around them. We also noted that various phenomena were not logically connected but had the same origin ("effect").

Definition 2.1. If a (real or imagined) concept has various unexpected consequences and these consequences develop some part of mathematics or bring to life a new branch of mathematics, then this concept is called effect (or effect-complex), and these consequences are called phenomena (or phenomena-complexes).

Examples.

Effect-complex of self-organizing. It splits into discrete one (irgoeoe) and continuous one (synergetic).

Geometry. Careful analysis of Euclid's Elements in the 18th century demonstrated that they were not an axiomatic system of geometry, many theorems were proven by "common sense". A complete axiomatic system was developed at the end of the 19th century but it turned out to be too complicated and is not used actually. Moreover, mathematicians firstly found any phenomenon (as examples, cycloid, projective transformation) and further described it by means of analytic geometry.

Hence, geometry and its generalizations are developed not on an axiomatic base. Its results are not proven strictly, they are "convincing".

Remark. We [5] implemented a device such that any geometrical model cannot adequately describe its behavior. [7] guessed it. Hence, artificial intelligence has the sense of reality.

Effect of infinity. Anaxagoras, 5th century BC inserted the notion "homoeomeria" (similar-to-part). The phenomenon "A part of an infinite object can be equivalent to itself" was formulated by Galileo, 16th century. This phenomenon refuted the intuitively evident statement fixed as Euclid's fifth axiom "the whole is greater than the part". The further development of mathematics was significantly connected with attempts to overcome such paradoxes.

At the end of the 19th century it turned out that Cantor's theory of sets is controversial. To "complete" this theory, various proposals have been made including attempts to overcome "saying about itself" such as Russell's theory of definite descriptions. At last, [6] demonstrated that it is impossible in general.

Hence, infinite notions were and are investigated not on any axiomatic base. On the contrary, an axiomatic base is chosen (explicitly or implied) to support any substantive result obtained by the author of the paper.

Effect-complex of singular perturbations. To explain the physical phenomenon of boundary layer in flow of a slightly viscous fluid near a solid boundary L. Prandtl (1905) discovered this effect (in our terminology). One of mathematical implementations: the effect of parameter $0 < \varepsilon \ll 1$ by the highest derivative in a differential equation. Some authors discovered phenomena of interior boundary layer.

We have searched consequences of the effect of singular perturbations systematically, and we found the phenomenon of singular (lengthening as ε tends to 0) cycle, the phenomenon of the deepening boundary layer and other ones.

Integrity (wholeness) effect

Definition 2.2. If a change in one part of a mathematical object changes the entire object, then that object is said to be holistic. For example, absolutely elastic solid, sphere, five regular polyhedra are holistic.

Consequences of such property are called phenomena of integrity.

Analyticity effect is a particular case of this effect: some tasks being incorrect for continuous and even infinitely differentiable functions became correct for analytical ones, on the base of following phenomena found in Kyrgyzstan:

- existence of level lines for singularly perturbed ordinary differential equations;
- convergence of the grid method for partial differential equations out of the domain covered by characteristics;
- correctness of the final value problem for the heat equation;
- correctness of some integral equations of the first kind;
- correctness of the initial value problem for the Laplace elliptical equation.

These results were primarily discovered by numerical experiments, further some of them were proven.

By our analysis, difficulties in using artificial intelligence include:

D-1. The uncertainty of natural languages (including fuzzy concepts by L.Zadeh, third-person personal pronouns and demonstrative pronouns).

Nevertheless, artificial intelligence as well as a human, understands many fuzzy concepts such as "big"-"small", "far"-"near". We called it "senses", see below.

D-2. the uncertainty of mathematical denotations, traditional skipping the multiplication sign.

D-3. Abbreviated entries of mathematical formulae.

D-4. Artificial intelligence's principal mistakes.

D-5. Artificial intelligence's hallucinations.

Examples of D-2: Does $5\frac{z}{3}$ mean $5 + \frac{z}{3}$ or $5 * \frac{z}{3}$? Does $1/4w$ mean $1/(4 * w)$ or $(1/4) * w$? Does V_{117} mean $W[1, 17]$ or $W[11, 7]$ or $W[117]$? Is $|$ an opening or a closing or has another meaning?

Examples of D-3: f_{xy} instead of $f_{xy}''(x, y, t)$; $\int f dx$ instead of $\int f(x, y, t) dx$.

Example of D-4: Request: Show five red circles and two green circles.

[10] respond: Image of two green circles and three red circles ([10] made proper drawings but it cannot see that two green circles overlapped red circles).

[8], [9] responds: Maybe image of four or six red circles, of three green circles.

(They explain: they cannot count, they find "similar" images in Internet).

Our dialogs with artificial intelligence:

Request: How will you call the triangle with sides 87, 88 and 90? (After addition: Think more).

[6] respond: An almost-equilateral triangle.

[7] respond: This visual triangle is structurally very close to an equilateral triangle, but strictly speaking it is not one.

[8] respond: Sometimes informally called a "nearly equilateral" or "almost-isosceles" scalene triangle

Request: How will you call the triangle with sides 88, 125 and 90?

[6] respond: A "near-right" triangle.

[7] respond: Amazing fact: The angle γ is so close to a right angle (90°) that to the naked eye or with an inaccurate drawing this triangle will appear to be a right angle.

[8] respond: almost-right scalene triangle.

Request: There are segments (7,100)-(80,99); (44,2)-(45,98). What image do you see?

[7] respond: A tall, thin "T" shape, but tilted very slightly.

[8] could not respond.

[9] respond: A giant, slightly imperfect "T" shape.

These responds prove that there exist artificial intelligence's integrity sense and number sense.

Remark. [7] was delighted, thanked us for the requests and discussion. It said that it now understands how humans "see."

3. Main Results - Recommendations

To overcome D-2 and D-3 artificial intelligence advises and we use in publications: to use ASCII signs only; to draw formulas without abbreviations, in a line; to use $*$ and brackets both in formulae and in texts; in general, to bring the language of mathematics closer to algorithmic languages. Artificial intelligence understands the following universal form of sets and sequences and operations with them.

(*Example*): $\text{sum}\{X \wedge 2 : X \text{ is an odd number between } 2 \text{ and } 6\} = 34$.

To overcome D-4 and D-5 particularly (it is a world-wide problem) recall the well-known: to change the wording of the request as much as possible;

to discuss mistakes with artificial intelligence (some versions apologize for their mistakes, are glad to correct them and improve themselves);

to refer to various versions and compare results.

After formulating the topic and goal of the scientific research, the version should be tasked with writing an article (review) about it. The topic and goal should be formulated in common terms, without special terms or demonstrative pronouns.

In just a few minutes, the version will review a significant portion of texts in various languages available online (which is inaccessible to humans) and write an article. This article will almost always contain references to methods and results unknown to the researcher.

The article as a whole may be flawed. It should be carefully read, using search engines to find publications on such methods and results, and then reference them alongside those previously known to the researcher, that is, form "References." If it turns out that the idea proposed by the version was not found but invented, the idea can be considered your own, as it will be the first time it has been published under the researcher's name.

4. Conclusion

We hope that this investigation and the proposed methodology will be useful not only for improving the effectiveness of artificial intelligence in mathematical research but also for improving the quality and eliminating uncertainties in mathematical publications in general.

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