ChatGPT excels in medicine but falters in basic algebra

Eli Bagno, Thierry Dana-Picard, Shulamit Reches

[ndp@jct.ac.il,bagnoe@g.jct.ac.il,shulamit.reches@gmail.com]

[1] Mathematics Department, Jerusalem College of Technology, Jerusalem,Israel

In memoriam of Eugenio Roanes-Lozano.

Lavoie [6] showed that the introduction of calculators in the classroom is a revolution similar to the switch from writing with a goose feather to writing with an iron quill. From time to time, new technologies appear in the world. Plotters, calculators, symbolic calculators, handheld devices, and more advanced Computer Algebra Systems. It is common sense that all these technologies enter the world of education. In particular, Engineering Education must involve various technologies in the courses, depending on the topics. An important reason is that the students have to develop a good literacy in technologies that they will use in their professional life. Moreover, because of the frequent development of new technologies, students have to acquire learning skills, which will be useful for lifelong learning.

Jerusalem College of Technology is an institution of Higher Education mostly devoted to High-Tech Engineering. Because of the large number of groups for every basic course, coordinators have to be appointed for these courses; the structure of the work is explained in [3]. Two of the authors are the coordinators of the two courses in Linear Algebra for engineers, and the other one is a teacher in the course . Every year, about seven hundred students are involved, divided into about ten lecture groups and more for practice sessions. This model has been developed at JCT for more than a decade [3], with continuous improvements, most of them allowed by technology. Recently a new technology, based on AI, has been released: ChatGPT.

ChatGPT is an impressive natural language processing tool that has made significant strides in recent years. It is capable of performing various tasks such as language translation, text summarizing, and even generating coherent and plausible stories. However, ChatGPT's abilities and limitations (see [2]) in mathematical problem-solving have to be thoroughly explored.

Our talk aims to examine ChatGPT's aptitude in mathematical problem-solving and the extent to which it can solve various math problems. Additionally, we will also analyze the

limitations of ChatGPT in math and the potential for future advancements in this field*.

ChatGPT has been tested for numerous possible applications in medicine, and its affordances have been analyzed; the success percentage is noticeable, but full success has yet to be achieved. [4]. A further remark about this software addresses the importance of communication using natural language [5]. This remark is of the utmost importance for us as educators. It has (almost) always been taken into account by software developers: generally, the syntax of commands in a Computer Algebra System is close to the way it would have been worked out by hand.

In this talk, we report on the first steps of ongoing research, which analyzes which benefits the teachers and the students can have from this technology in Linear Algebra. We elaborate also on some points from [9]. In particular, we show:

- Exercices in High-School algebra for which ChatGPT provides an accurate answer: elementary systems of linear equations;

- Examples in basic Undergraduate Linear Algebra where the system gives a correct answer;

- Examples in basic Undergraduate Linear Algebra where ChatGPT contradicts itself. Here we could identify problems mixing the inaccuracy of algebraic computations together with problems with recognition of what a set is.

In the last two cases, we tried to "teach" the system and made experiments using independent computers, in order for the system not to identify the user.

A complex instrumental genesis is at work [1, 7]: the teachers have to undergo such a process, and the AI-system too!

An analysis of the needed orchestration [8] with students is on its way also. Artigue [1] mentions that the implementation of a new technology depends on the "institutional culture". We are aware that some institutions in the world have already decided on the prohibition of using ChatGPt. Such a prohibition has been issued in Italy for the entire country, and cancelled a couple of weeks later with limitations. Our first results show that a more positive approach can be adopted. In particular, we identified that the system begins often by writing the definitions of the involved mathematical objects, an attitude that we try to educate our students.

Keywords
ChatGPT, Linear Algebra, Instrumental Genesis, limitations

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*This paragraph is a slightly modified version of an answer given by ChatGPT. It shows that, as far as text is concerned, things are acceptable. In our talk, we address mathematical issues.

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