

# OpenAI solved an 80-year-old puzzle

The implications of this breakthrough as well as reactions from academia

For nearly 80 years, a famous problem in discrete geometry had challenged mathematicians. All it took was a prompt from an internal OpenAI model to disprove a conjecture made by the late Hungarian mathematician Paul Erdős (see pic) about a puzzle he posed, known as the unit-distance problem.

Erdős posed a question in 1946 — given  $n$  dots on a sheet of paper, what is the maximum number of pairs that can be exactly one unit apart? He conjectured this number could grow only slightly faster than  $n$  itself — that is, roughly linearly in the number of dots. An internal OpenAI model has disproved the longstanding conjecture, providing an infinite family of examples that yield a polynomial improvement.

“For nearly 80 years, mathematicians believed the best possible solutions looked roughly like square grids,” the company wrote on X. “An OpenAI model has now disproved that belief, discovering an entirely new family of constructions that performs better.”

Even three years ago, LLMs struggled to solve arithmetic problems. Recent advances in reasoning models have significantly improved their performance on mathe-

matical benchmarks and competition-style problems. Many researchers view the result as a significant milestone in AI-assisted mathematical discovery.

“This is the first example of a result produced autonomously by an AI that I find exciting in itself, as opposed to as a leading indicator,” said Daniel Litt, assistant professor at the University of Toronto in Canada.

Equally impressed has been Timothy Gowers, professor at the Collège de France, “The solution to the unit-distance problem is a milestone in AI mathematics. If a human had written the paper and submitted it to the *Annals of Mathematics* and I had been asked for a quick opinion, I would have recommended acceptance without any hesitation. No previous AI-generated proof has come close to that,” he says.

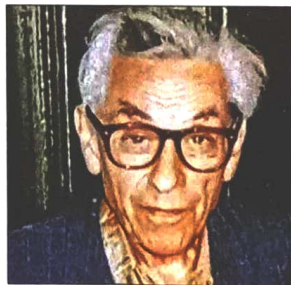
OpenAI presented its findings alongside 19 pages of companion remarks from prominent independent mathematicians.

The company behind ChatGPT said in a statement, “The result is also notable for how it was found. The proof came from a new general-purpose reasoning model,

rather than from a system trained specifically for mathematics, scaffolded to search through proof strategies, or targeted at the unit-distance problem in particular. As part of a broader effort to test whether advanced models can contribute to frontier research, we evaluated it on a collection of Erdős problems. In this case, it produced a proof resolving the open problem.”

Erdős’s research covered a many areas in mathematics, but his interest in number theory was life long. It is said he dedicated 19 hours a day to mathematics and authored over 1,500 works. In 1986 alone, he published 50 papers.

Over time, he helped shape mathematical fields such as random graph theory and combinatorics. He championed a branch of combinatorics called Ramsey theory.



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“The planar unit-distance problem was one of Erdős’s favourite problems,” Noga Alon, a mathematician at Princeton University in the US, writes in a companion paper to OpenAI’s announcement.

In 1982, Erdős offered \$300 for a proof or disproof of his proposed upper bound. The amount was later increased to \$500.

The success of AI can be attributed to various reasons. First, most people who tackled the problem tried to prove Erdős’s conjecture rather than disprove it. Second, where mathematicians tend to concentrate on a specific area of expertise, AI models can draw on dozens of mathematical disciplines at once to spot connections that no single specialist is likely to see. Third, AI can persist with a method over a longer period of time rather than abandoning it.

The breakthrough underscores the intensifying race between AI companies to demonstrate frontier capability and the financial stakes behind it. Anthropic, the company behind the chatbot Claude, has confidentially filed for an initial public offering, while OpenAI, which started the AI boom in 2022 with ChatGPT, is reportedly set to do the same later this year.

Mathures Paul