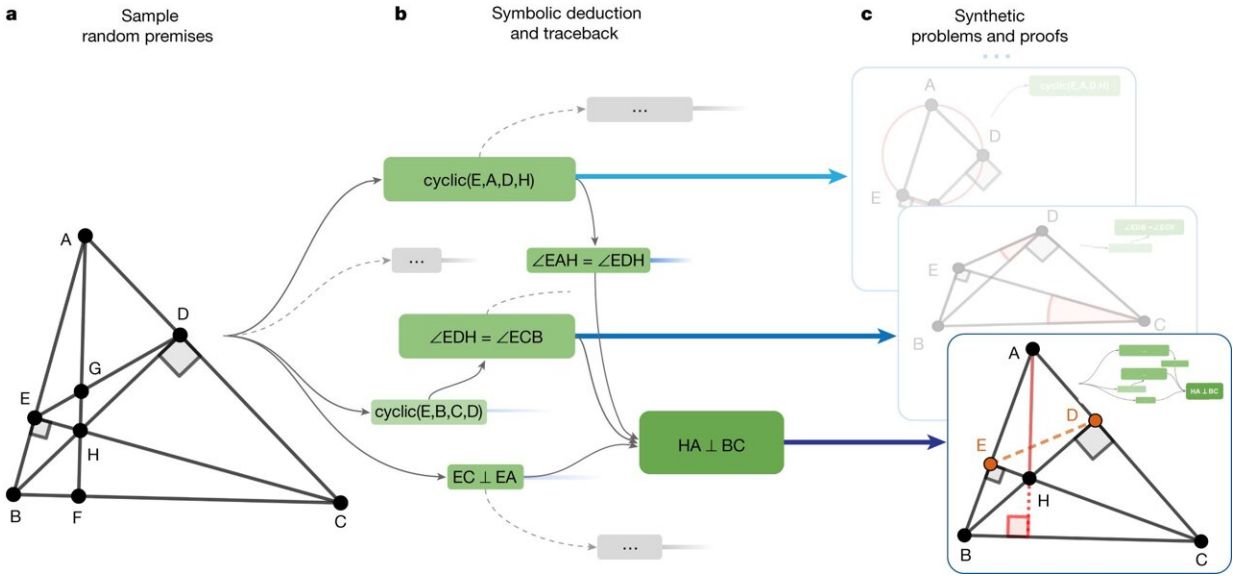


# DeepMind's AI system AlphaGeometry able to solve complex geometry problems at a high level

January 19 2024, by Bob Yirka



AlphaGeometry synthetic-data-generation process. a, We first sample a large set of random theorem premises. b, We use the symbolic deduction engine to obtain a deduction closure. This returns a directed acyclic graph of statements. For each node in the graph, we perform traceback to find its minimal set of necessary premise and dependency deductions. c, The minimal premise and the corresponding subgraph constitute a synthetic problem and its solution. In the bottom example, points E and D took part in the proof despite being irrelevant to the construction of HA and BC; therefore, they are learned by the language model as auxiliary constructions. Credit: *Nature* (2024). DOI: 10.1038/s41586-023-06747-5

A team of AI researchers at Google's DeepMind, working with a colleague from New York University, has developed an AI system called AlphaGeometry that has demonstrated an ability to solve complex geometry problems at a high level.

In their paper [published](#) in the journal *Nature*, the group describes their new AI system and the ideas they used in its development. The team at *Nature* has also published a [podcast](#) giving an overview of the new AI system.

Proving mathematical theorems can be a challenging endeavor, and people who can do it well are considered to be valuable assets to institutes of higher learning, and in some cases, companies, such as Google. So a means of identifying such individuals has been established—the International Mathematical Olympiad. It is described as the World Championships of Mathematics competitions for high school students.

Because of many of the difficulties inherent in using math for many modern applications, such as the design of computer systems, computer scientists have been hoping for AI systems that can solve complex [math](#) problems and/or prove theorems. Unfortunately, up until now, AI systems have not performed nearly as well as hoped. In this new study, however, the team at DeepMind has now created an AI system called AlphaGeometry that competes at the level of gold-medal-winning students in the International Mathematical Olympiad.

To create AlphaGeometry, the research team used a new approach. Rather than attempting to teach the system how to prove theorems using multiple examples, they used a neural language model that allowed the system to train itself. This was done by synthesizing millions of known theorems and proofs with various levels of complexity. They also added a symbolic deduction engine to help the system learn and solve

increasingly [complex problems](#) without assistance by humans.

The researchers then tested their new system by giving it 30 problems faced by students in the International Mathematical Olympiad over the years 2002 to 2020 and found that it was able to solve 25 of them considerably better than prior AI systems. They noted that its performance was on par with the average gold medalists at the competition.

The research team notes that the system is currently programmed to work with specific forms of geometry but suggests it may be able to expand its repertoire to other domains.

**More information:** Trieu H. Trinh et al, Solving olympiad geometry without human demonstrations, *Nature* (2024). [DOI: 10.1038/s41586-023-06747-5](#)

DeepMind blog post: [deepmind.google/discover/blog/... system-for-geometry/](#)

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