Assignment-05

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1 AI and Mathematics

This YouTube video is regarding a talk given by Terence Tao, one of the most renowned people in the field of mathematics. He being a maths prodigy since his childhood today is serving as a professor in the University of California. He earned a gold medal in IMO at the age of 13 making him the youngest gold medalist at the IMO.
Tao's talk begins by briefing the audience about how AI has changed the way mathematics is done stating an example about Alpha Geometry which can solve IMO geometry questions now.But research mathematics is different from competition mathematics. How long have we been using computers for maths? Starting from the abacus tool of Romans, Tao gives an instant of World War II. During this war women were employed to do tasks like ballistics. Tao points the usage of tables which have been outdated today by the use of calculators. Mathematicians use databases like the Online Encyclopedia of Integer Sequences (OEIS) to find patterns in numbers. He then gives a historic example of Gauss who manually formulated and prooved the Prime Number Theorem. Later machines helped confirm various other results like Birch and Swinnerton-Dyer conjecture.Then he gives today's context where in he emphasisess on the AI formal proof assistants which are AI driven tools that verify the accuracy of proofs.
One of the first example of computer formulated proof is the Four Color Theorem, which used both human and computer skills.One more instance where the computer was needed for the complexity of the problem is the Kepler Conjecture.AI also has enabled collaborations within maths research. Tao shares his experience with a project that had many contributed. He then used Lean Programming which allowed different parts of the proof to be verified independently. Then he states an example using knot theory.Machine Learning is used to derive hidden relations between these knots. By training the neural networks on these large datasets of knots, researchers have been able to collaborate on every aspect.Then he starts talking about Large Language Models like GPT-4 which has become more popular nowadays. He mentions that they have been tested for solving IMO level problems but their success rate is still low about 1%.The major reason of this low success rate is that they don't solve the problems as humans do but instead guess the next step based on large chunk of data which often lead to errors. Despite this problem large language models can be used as tool for productive tasks and exploring new ideas. Tao shares an example where he used these language models for solving a combinatorics problem. But he adds on this saying that in this process many suggestions were unhelpful but one of the response by the model was unique and finally led him to success.
Tao is optimistic about the future of AI in the field of mathematics. He thinks of a future where AI will be able to use its large junk of training data to generate new lemmas, proofs, and various other results by identifying the patterns that humans might miss. He also believes that AI could enable mathematicians to handle entire class of problems at once , where one used to solve one problem at a time earlier.Tao wants this field of mathematical research to be more efficient than ever before.
Tao concludes his talk by saying that AI is making significant progress in the whole field of mathematics but is still far from replacing humans. For now, he believes AI is just a valuable tool that can help with solving complex problems with aided assistance by humans.And humans will continue to play an crucial role in guiding AI in the whole process and also in making the model better.
The future is going to be really exciting. We will still be proving theorems in the traditional way , but with AI, we'll be able to do things that were previously thought complex and tough. Mathematics will evolve, but it will always require the human mind to guide and create new paths.