

Mathematics is alive and evermore important

Mathematics is not a competition, let alone between humans and machines. Rather, it is a profoundly human endeavour of systematically understanding the world around us through abstraction and critical thinking — and as such, it is evermore important.

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The Navier–Stokes problem, one of the famous Millennium Problems of mathematics, was open for about 90 years. When OpenAI announced in early September 2026 that it had solved it with AI, this caused a great uproar. Only a month later, OpenAI followed up by releasing 722 papers at once, presenting groundbreaking solutions to well-known problems in nearly all major areas of mathematics. Does this now sound the death knell for mathematics, as some commentators are now insinuating on social media?

This claim is vastly exaggerated and reflects a very one-sided view of an age-old science. Mathematical research is often portrayed as a race among ”geniuses” – human or artificial – competing to be the first to solve open problems. But the reality of mathematical work is usually quite different: This is true for schools and universities as well as for research, today as well as in antiquity. Rather, mathematics is a collaborative endeavour of humankind. Its goal is not to win some competition, but to explore the structure and aesthetics of our environment through abstraction and systematic, logical thinking.

To get an idea of what this looks like in practice, we can look at a historical example: In the 17th and 18th centuries, mathematicians were experimenting with numbers and divisibility when they stumbled upon a puzzling phenomenon of surprising symmetry: the law of quadratic reciprocity. Roughly, for any two prime numbers p and q , one can ask whether there is a square number that leaves the same remainder as q when divided by p , and the law describes what happens when p and q are swapped. In 1796, the famous mathematician Carl Friedrich Gauss was able to prove this statement, at the time a fundamental conjecture. But Gauss was not satisfied with his proof. The proof showed that the theorem was true, but it did not provide any deeper insight into *why* this was the case. The beauty of the theorem indicated to Gauss that its story was not yet fully told. Hence, he worked out another proof. And another one. And another one. A total of eight proofs by Gauss are known, countless others have been added since.

What is the point of all of these proofs when any single one of them shows, once and for all, that the law is correct? Are they not a waste of time?

Quite the opposite. Today, we view the quest for a deeper understanding of the law of quadratic reciprocity as the starting point of an incredible development that has carried us to ever-new heights of mathematical insights. It is currently experiencing another golden age, for example in the so-called Langlands Program, which connects a wide variety of topics within mathematics. But it also continues to bring us a wealth of fascinating discoveries in many other areas of research mathematics.

Would this fantastic development have taken place if Gauss and the mathematical community of his time had been satisfied with the first proof?

The history of quadratic reciprocity illustrates that solving major mathematical problems is not merely a matter of finding valid answers – yes or no, true or false. A “good” solution provides fundamental insights into the entire landscape of ideas in which the problem is embedded. Perhaps it even reveals important new concepts that broaden our horizons and lead us into uncharted territories. Mathematics, then, is not merely a problem-solving factory: Quite often, the journey itself is the true destination.

For this reason, the rising flood of sensational AI proofs does not automatically lead to a deeper human understanding of mathematics. Due to inadequate documentation, many AI-written proofs can currently only be understood with considerable effort. Human work on these proofs is therefore only just beginning: What are the key ideas? Do they reveal more about the broader landscape? Or do they fail to give us a feeling for *why* a deep theorem holds? The process of answering these questions is currently very tedious. AI-proofs that are readily available, technically correct, but not particularly illuminating can therefore turn us away from a “solved” problem in frustration. Then we may miss out on innovative approaches that lead to a wealth of new discoveries – just as they did for Gauss.

There are other good reasons to be cautious: In pure mathematics, what eventually turns out to be useful in applications are often not the problems themselves, but rather the methods and structures that emerge on a path of free, curious exploration. The AI researchers Joel Lehmann and Kenneth Stanley refer to this as the “objective paradox”: They argue that key innovations are often not achieved by setting a fixed goal and trying to reach it. Rather, they arise in surprising ways when we set out in new directions, guided by vague criteria such as intuition and aesthetics. This spirit of open-ended innovation lies at the very heart of mathematics. Incidentally, this is a manifestation of human intelligence and creativity that machines are currently still struggling with.

All of this is currently leading to a healthy amount of skepticism regarding AI-generated proofs in the mathematical community. For example, 28 Fields Medalists – the “Nobel laureates” of mathematics – recently issued an open letter. Among other things, it warns that with increasing automation of human work, such as mathematical problem-solving, we must not lose sight of what this work was supposed to achieve in the first place.

This applies just as much to research as it does to the wider job market. While AI systems are indeed capable of taking over specific tasks that previously fell within the scope of mathematicians in the workplace, this does not imply that mathematicians will become replaceable as a result. After all, mathematics education has never been vocational training: It does not only teach versatile techniques and concepts. Its primary goal is to sharpen the mind and instill a combination of analytical and critical thinking with free creativity. These skills make mathematicians versatile, adaptable, and capable of learning quickly. Indeed, such critical thinking skills should become increasingly important in the future if we do not want to be controlled entirely by machines – in the workplace as much as in society at large.

Above all, mathematics as a means of engaging with the world we live in is an essential part of human culture, spanning continents and millennia. We must not give up this profoundly human desire to understand. To do so would be a regression into self-imposed immaturity, a reversion into the darkness of the pre-Enlightenment era. This is one of the greatest dangers posed by the increasing automation of intellectual work.

On the other hand, this stance should not be equated with “rebellion against machines”. Throughout its history, mathematics has always been open to technological innovations. The revolutionary advances in AI now open up exciting new possibilities for mathematical work, if we make sure that they are introduced carefully, in a well thought out way, that continues to be critically evaluated. Communities are adapting, and the integration of AI into mathematical studies and research is already underway.

We can therefore be optimistic that AI will now help us advance our exploration of the world around us. The human endeavor of mathematics is by no means over. It still holds an infinite number of fascinating secrets and untold mysteries. Now, more than ever, we should not allow ourselves to be discouraged from discovering them!