Mathematics of the Future

Pavel Etingof and Slava Gerovitch
Department of Mathematics, MIT

October 6, 2026

Abstract

Rapid advances in artificial intelligence are transforming mathematical research, raising critical questions about the role, training, evaluation, and social value of human mathematicians. We argue that, rather than making mathematicians obsolete, AI will prompt a reorientation of the profession away from an "ownership culture" centered on priority and publication records and toward intellectual agency: deep understanding, judgment, vision, communication, and stewardship of a shared mathematical culture. Mathematicians can use AI to explore a rapidly expanding mathematical landscape, interpret and synthesize AI-generated knowledge, repair and formalize the existing literature, and develop new forms of exposition and publication. We propose that hiring and graduate education rely more heavily on sustained mathematical interaction, including talks, discussion, oral examination, mentoring, and collaborative work, rather than treating papers alone as decisive evidence of ability. We also outline a model for AI-assisted research labs that combines collective human thinking with careful use and checking of AI output. Acknowledging serious ethical, social, and epistemic concerns and respecting those who choose not to use AI, we argue that the central challenge is not to compete with machines in producing theorems, but to preserve and expand humanity's capacity to develop, understand, and communicate mathematics.

Contents

1 Introduction **2**

2 The functions of mathematics **3**

3 Why will society need mathematicians? **4**

4 How should mathematicians be evaluated? **5**
4.1 Demise of the ownership culture 5
4.2 Hiring criteria 7

5 What should mathematicians do? **9**
5.1 A wider mathematical world 9
5.2 The Mathematical Library of Babel 11

5.3 The big cleanup 12
5.4 Writing and publication 12
5.5 A shared mathematical culture 13
5.6 AI-vegan mathematicians 14

6 How should mathematicians be trained? 15
6.1 Learning with and without AI 15
6.2 Courses and examinations 16
6.3 Graduate study 17
6.4 An AI research lab 18

7 Advice for young mathematicians 19

8 The epilogue 20

1 Introduction

In 2026 frontier LLMs gained the ability to do mathematical research, and this ability is rapidly growing. Long-standing open problems began to fall to AI-powered attacks one after another. LLMs can now generate a decent (and sometimes excellent) mathematical result within an hour, with minimal or no intervention by a human mathematician. While it is not yet clear how far this trend will go,[1] there are good reasons to believe that it will continue, with AI uncovering a large amount of highly interesting mathematics in the immediate future. For the growth of mathematical knowledge, this is extremely exciting.

Yet this comes at a steep price. These developments raise fundamental questions about authorship, credit, evaluation, and the role of mathematicians.[2] It is already clear that in the years and even months to come, our community will have to undergo profound change. Even if AI progress stopped today, mathematics could no longer be practiced the old way, and we would still need to adapt our teaching, research, and communication. This is likely to be challenging and confusing, in particular because AI is developing so fast.[3] As with many technological transformations, much of this development is driven by the business interests of large companies, which are not necessarily aligned with those of mathematicians [SM]. We are in for a period of uncertainty and anxiety, especially for early-career mathematicians. Indeed, some young people are already having second thoughts about going into mathematics.

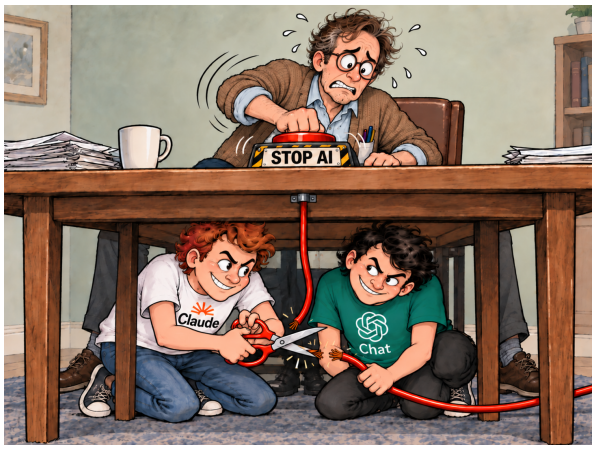
But there is no button to opt out.[4]

[1] AI models do better on some types of problems than on others, and successes alone do not tell us the whole story - how many attempts failed, how much compute or human guidance was required, etc.

[2] The Leiden Declaration lists five characteristic values of mathematical research and argues that AI threatens each of them [LD].

[3] However, this transformation is likely to lag behind AI development. High costs, access restrictions, and institutional inertia may dampen its effect on the mathematical community.

[4] To lighten up the narrative, we illustrate it by a few AI-generated cartoons, which are not to be taken too seriously.



We can try to influence this process constructively – and the recently formed independent Advisory Group on Mathematics and Artificial Intelligence [AGMAI] is one welcome effort – but we are unlikely to stop or even substantially slow it down. We should adjust to this reality while focusing on the breathtaking opportunities ahead.

It is difficult to predict how mathematics will adapt. The future of our profession will depend not only on what we do, but also on how the larger society values and funds our work. Moreover, related changes in education, science, and the wider economy will affect us in ways we cannot foresee. Yet it is time to start thinking about this future.

Our goal here is to imagine mathematics in this new world and try to answer four basic questions:

- **Q1.** What should mathematicians do?
- **Q2.** How should mathematicians be trained?
- **Q3.** How should mathematicians be evaluated?
- **Q4.** Why will society need mathematicians?

We believe this new age, albeit full of uncertainty, is a particularly exciting time to be a mathematician.

2 The functions of mathematics

Arguably, mathematics has four principal functions.

- **F1.** Discover fundamental **truths** about the universe.
- **F2.** Serve as part of human **culture** and understanding of the world.
- **F3.** Provide **tools** for applications.
- **F4.** Foster human **intellectual development and analytical thinking**.

All four functions will remain important and can be greatly enhanced in the age of AI. And mathematicians should lead this process. This will guide our answers to the four questions above.

3 Why will society need mathematicians?

We start with the last question – the one most dependent on trends in the larger society and a major source of anxiety among young people interested in mathematics. Will there be enough jobs in mathematics, and if so, how will they be funded? Does it still make sense to pursue a career in mathematics?

The thing to keep in mind is that professionals in every field now face the same questions, and in today's fast-moving world no meaningful long-term prediction is possible. Still, there are reasons to think that mathematicians are in a relatively good position compared with many other intellectual professions.

- Even if AI becomes so strong at mathematical research that human participation no longer makes much difference, mathematicians will still be needed to formulate and prioritize questions. While AI may eventually become better than us at this too, the truth-finding function of mathematics is not just to produce more theorems but to expand **human** knowledge and understanding.

- The cultural function of mathematics is irreducibly human and cannot be fulfilled without mathematicians. They will be needed as interpreters and communicators of mathematical culture, even if they take a secondary role in discovering new mathematics.

- Mathematicians will also be needed to implement the tool-providing function of mathematics, as the opportunities for applying mathematics will be greatly expanded. In particular, mathematics will play an important role in AI-related areas of great social consequence, notably in AI safety. These activities offer promising directions for employment of mathematicians [Sah].

- Mathematical education will remain essential to the intellectual-development function of mathematics. AI will be a powerful educational tool, but there are good reasons to expect continued demand for human teachers, since human beings are fundamentally social. Moreover, the educational system has considerable inertia, which should help sustain teaching positions in the foreseeable future [H].[5]

- Society has long supported pure mathematics for its epistemic value, not just for direct practical significance, and this rationale will remain as AI participates in producing mathematics.

- Some positions in mathematics are supported by endowments donated specifically for academic mathematics. Such funds generally cannot be repurposed and should therefore provide institutional stability.

- Mathematics PhDs who leave academia have historically enjoyed excellent employment prospects because of their analytical and critical thinking skills. These skills will still be needed in the AI era.

[5]Indeed, students have long had access to excellent online texts and lectures, and more recently to AI tutors, yet in-person university teaching remains essential. University teaching is shaped by educational and institutional priorities, not simply by the cheapest available means of delivering information.

These considerations give reasons to expect continued demand for mathematicians. There is, however, another argument which may become increasingly important.

A strong mathematical community is a form of **intellectual reserve** [Sah]. There is no telling which mathematical expertise will be needed, especially in a world where AI may produce scientific and technological developments at an unprecedented rate. Such expertise must already exist, it cannot be created quickly. Producing mathematicians with deep understanding and good judgment requires many years of training, research, and participation in a living mathematical culture [Ko].

Maintaining this reserve requires both education and research. Mathematical education continually renews society's capacity for rigorous analytical thought. Completely outsourcing it to AI would therefore risk a genuine loss of control: we could become increasingly dependent on sophisticated technologies while losing the human capacity to understand and question them. Research is equally essential, because frontier competence is maintained only by exercising it. Education replenishes the reserve; research keeps it capable of operating at the frontier.

This gives society a strong reason to fund mathematics even if AI eventually produces most new theorems. We maintain fire departments before fires occur and strategic reserves before emergencies arise. In the same way, society may need more mathematical expertise than its immediate needs seem to require. Supporting mathematics means preserving our capacity to understand and respond to developments we cannot yet foresee.

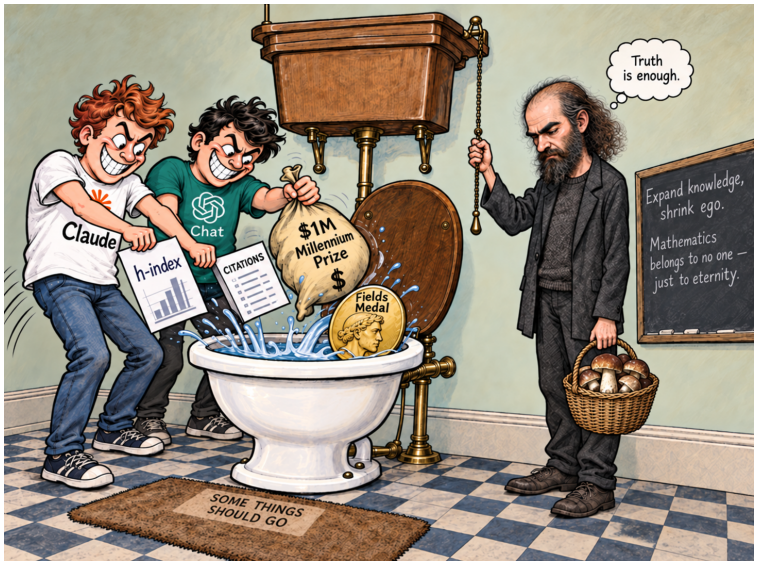
4 How should mathematicians be evaluated?

4.1 Demise of the ownership culture

For much of its modern history, the social structure of mathematics has rested on what we might call **the ownership culture**. Mathematicians compete for priority in proving the best theorems they can, and once a result is established, its authors acquire a lasting claim to fame. What mathematicians own in this system is not the theorem itself, but the credit for having discovered it: subsequent works are expected to cite and acknowledge them. Careers, reputations, prizes, and other forms of recognition are built to a large extent upon publication lists whose size (in a suitable metric) matters. The Leiden Declaration explicitly affirms a related principle: mathematical results are attributable to specific human authors, to whom both credit and responsibility belong [LD].

Will this culture survive the age of AI? We think not, because the strength of papers will become less correlated with the mathematical level of their authors.
If most of the heavy lifting in theorem proving is done by LLMs, the notion of individual credit may gradually lose much of its meaning [B, Go]. Perhaps this would not be such a bad thing: historically, the clashing egos of mathematicians have generated a great deal of conflict, and mathematics may be better off if those egos retreat from the business of "owning" results.[6]

[6]Frank Calegari identifies ego as perhaps the thorniest of the systemic issues facing the field, and argues that the present moment calls for a great deal of humility [Ca].



That being said, the ownership culture has served mathematics as an organizing framework. In particular, it has supported a system for evaluating mathematicians by relatively objective criteria, and replacing it will be a serious challenge.[7] For all its imperfections, the old system was working. But in the age of AI, preserving it may no longer be realistic.

This is not to suggest that the day an AI-assisted solution of the Navier–Stokes Millennium Problem was announced should be declared the day of the mathematical "socialist revolution," when private ownership of mathematical results is abolished altogether.



This transition will take time and, in any case, will not erase the credit due for earlier work. For now, while careers still depend on credit, we must continue to take care to

[7]Thomas Koberda warns that qualities such as judgment, taste, and stewardship are much harder to measure than theorem counts and therefore easier to manipulate. If output matters less, senior mathematicians could gain too much power to decide whose work shows "taste," reinforcing prestige hierarchies and patronage [Ko]. Any replacement should therefore draw on several kinds of evidence and independent evaluations. The goal is to move beyond crude metrics without replacing them by arbitrary judgement.

acknowledge every relevant previous publication, especially in AI-assisted work, where an LLM may regurgitate someone else's ideas absorbed during training.[8] We should also be careful, when doing AI-powered research, not to "scoop" mathematicians who have worked on the same problem for a long time in the traditional way and whose careers may depend on receiving credit for that work. The whole notion of "scooping" may no longer be relevant in the not-so-distant future, but for the moment it remains real, and we have to be mindful.

For the same reason, while the ownership culture is still in place, large-scale releases of important mathematical results by AI companies – especially in a half-baked form that still requires substantial work – could be counterproductive, even if the companies themselves are not claiming credit for them. Indeed, imagine a city in which money is made of gold. Suddenly strangers arrive with enormous sacks of gold coins and begin throwing them into the streets. The result will be a frenzy: people will trample over one another to grab as much gold as they can. Others, who have no taste for such a gold rush, may decide to leave the city altogether.



This may well become less problematic with time, as people recognize the futility of such competition in the age of AI and turn their attention increasingly toward learning and understanding mathematics rather than owning it. In our metaphorical city, this would be the moment when people realize that the strangers possess a philosopher's stone and that fresh gold will be arriving every day. Once gold is no longer scarce, there is little point in fighting over it, and eventually it can no longer serve as currency.

Mathematical credit may undergo a similar transformation. But this change in values and institutions will not happen overnight. The transition will be turbulent, but also, in an important sense, deeply liberating, ushering in a more open and collaborative mathematical culture.

4.2 Hiring criteria

So, with the ownership culture in decline, how should we compare the merits of mathematicians in hiring?

[8] In fact, careful citation of previous results will always be the norm, it's just that after a while these citations will no longer have any practical significance for the cited authors.

The goal will remain the same: to hire good mathematicians who contribute to a strong intellectual environment. What will change is how they are identified. Traditionally, the quantity and, much more importantly, the strength of a candidate's publications have been viewed as the best indicators of mathematical level. As AI increasingly decouples the level of papers from that of their authors, this evidence will become less reliable (although at first this will matter mainly for junior hiring, since more senior mathematicians will retain meaningful pre-AI track records).

We believe that the main meritocratic criterion should instead be **intellectual agency** [Ko]: broad and deep knowledge, genuine understanding of mathematics and its connections, sound judgment, independent vision, and the ability to communicate all this to others.



Since intellectual agency cannot be read reliably from a publication list, hiring will have to rely much more on direct mathematical interaction: talks, interviews, and sustained conversation [Li3]. Letters of recommendation will still be very important, but should likewise be grounded in substantial personal interaction.

Should a candidate who proves a good theorem with extensive help from AI be valued less than one who proves an equally good theorem without it? We think they should be treated equally. Indeed, the boundary between human and AI contributions will often be impossible to reconstruct reliably, and such a preference would discourage the use of AI and incentivize its concealment. Hiring committees should assess mathematicians, not the provenance of their theorems. What matters is their command of the field: what they understand, what connections they see, which questions they regard as important, and what strategic vision they can offer.

Hiring should therefore consider a broader range of evidence.[9] We will have to start judging mathematicians by their knowledge, understanding, and vision, rather than by the papers that bear their names.

[9]Exposition, teaching, conceptual synthesis, the ability to make sense of mathematics, see its larger structure, and explain why it matters can all reveal intellectual agency [Kra]. Thurston famously listed many such activities as "non-credit-producing" [T], but now they should become exactly the ones that **do** bring recognition.

5 What should mathematicians do?

This brings us to a fundamental question: if AI becomes better than humans at many essential aspects of mathematics, what would be left for mathematicians to do? We believe this question should be approached anthropocentrically rather than "Anthropico-centrically" (with all due respect to Claude).

Mathematics is ultimately for **us** to learn and understand. For all its extraordinary power, AI is meant to be a tool for human purposes. But it is a remarkable one: it can give us access to ideas we could not previously have hoped to understand, and perhaps could not even have imagined. From this perspective, there is much to look forward to.



This does not mean that nothing will be lost. Discovering something new is a truly thrilling experience, and many mathematicians have built their working lives around it. But it is only one of the pleasures of mathematics. On his 100th birthday, September 15, 2026, Jean-Pierre Serre opened his talk "Plaisir des mathématiques" with the words: *"So, what is the topic of the little story I am going to tell you? The topic is pleasure. What kind of pleasure? Well, first there is the pleasure of the mathematician who discovers things, but I don't feel like talking about that. I prefer to describe to you the pleasure one finds in watching mathematics move forward."* [Se] This "watching" is by no means passive; it implies active engagement with this "movement forward", as evidenced by Serre's own illustrious career. A novel argument may surprise us, a new connection may change our thinking, and a classical subject can become a lifelong fascination. These pleasures do not depend on us being the first to discover the mathematics. And as AI accelerates mathematical progress, we will experience mathematics moving forward on a scale no previous generation has seen.

5.1 A wider mathematical world

As long as mathematics has existed, mathematicians have spent much of their time chipping away at the mathematical permafrost, hoping to uncover only a handful of truly coveted gems in a lifetime. If AI takes over much of this work, we will have more time to explore the landscape.



Many of us specialized early because our careers required it; now we may have the opportunity to range more widely. Algebraists can learn PDE and Fourier analysis, analysts can explore homotopy theory and algebraic geometry, and AI can help us enter unfamiliar subjects through ideas we already understand.



We will not just be catching up with a fixed body of knowledge. Mathematics will never be "solved" as a finished subject. Its universe expands as we explore it: new results reveal unexpected connections, call for new definitions, and open new directions. Every advance will expose new questions. In this sense, AI may create more room for original mathematics by enlarging the space in which new questions can be asked.

So is there still room for human creativity? Absolutely. At the moment, an experienced and mathematically sophisticated AI user is appreciably more powerful than AI alone. This may change with time, but in any case, a mathematician can use AI extensively and still ask an insightful question, invent a useful definition, recognize an unexpected analogy, choose

a new direction, or find a viewpoint that explains a phenomenon. AI may make such work far more efficient, and may contribute new ideas, but the expanding frontier makes room for mathematicians to propose new questions and pursue problems that did not exist, or were not visible, before [Li3]. Creativity will not disappear; it will simply operate on a frontier moving outward faster than ever.

5.2 The Mathematical Library of Babel

Following [Li1], let us imagine a mathematical version of Borges' Library of Babel, largely produced by AI and so vast that most of it will never be read by a human being. Unlike Borges' original library, which contains every possible text and hence an ocean of nonsense and falsehood, the mathematical library we have in mind would consist of results that have been reliably checked. The problem would no longer be separating truth from nonsense, but navigating an overwhelming abundance of truth. Some of its contents may also lie beyond our direct comprehension. Two kinds of AI agents could roam this library: some expanding it through new discoveries, others distilling its contents, selecting what is relevant to our questions and rendering it in human-friendly form. Mathematicians would then serve as interpreters between humanity and an "alien" mathematical civilization.



Even if AI excelled at both tasks, we would still have to internalize this mathematics. Explanation is not yet understanding: mathematicians would have to absorb the ideas, connect them with what they already know, and learn to use them. This would remain genuine mathematical work, however much help AI provides.

This suggests a different way to organize research. A group of mathematicians could spend a term understanding a new body of ideas, comparing approaches, and searching for a common framework. They might discover new results along the way, but their success would not depend on being first to prove a particular theorem. Their achievement would be to make a previously inaccessible part of mathematics intelligible to a human community.

Last but not least, this Library of Babel, however enormous, will always be finite, whereas mathematics is infinite. Mathematicians will therefore remain not only its readers and interpreters, but also its contributors, asking new questions and pursuing them, perhaps with the help of AI, at the ever-expanding horizons of mathematics.

5.3 The big cleanup

AI also creates an extraordinary opportunity, and increasingly a responsibility, to clean up the mathematical literature. We have inherited a magnificent body of work, but also errors, gaps, obscure arguments, incompatible conventions, and results rediscovered under different names. Frontier AI models are already highly effective at detecting such problems.



Mathematicians should take advantage of this: in particular, we would encourage authors to have their own papers systematically checked by strong AI agents, just as they would ask a careful colleague to read them.[10]

The same tools can be used at scale. The entire body of mathematical literature can be checked proof by proof, missing details supplied, arguments simplified, equivalent formulations compared, and dependencies made explicit. Increasingly, this should be accompanied by formalization in Lean. Formal verification and human understanding are complementary: Lean can certify a precisely stated argument, while exposition must explain why it works and what it means.

The goal is a literature that is both correct and clear. In each area one could identify important *open exposition problems*: constructions that need motivation, proofs whose mechanisms remain obscure, or theories whose relationships are poorly understood [San]. With human mathematicians directing AI agents, we may be able to leave the next generation a literature that is more reliable, better organized, and easier to understand than mathematicians ever had.

5.4 Writing and publication

As AI makes mathematical output abundant, publication must do more than merely record results. Repositories could record precise statements, dependencies, versions, and verification status, while journal articles may increasingly concentrate on explanation and synthesis, guiding readers through a technical record maintained elsewhere.[11]

[10] Cohn discusses the *technical debt* created by poorly explained and insufficiently checked mathematics [Co]. AI gives us an opportunity not only to avoid adding to this debt, but also to reduce its amount in previous writing.

[11] *Palomar* already provides a registry of Lean-verified mathematics [Pa].

AI will also play an increasing role in refereeing, and formal verification may eventually become routine where the necessary infrastructure exists. Neither removes the author's responsibility: as long as a paper bears our names, we should understand its main ideas, be able to defend its claims, and take responsibility for them [An].

The decline of the ownership culture could also make room for a completely new kind of publication. An AI-produced mathematical text may be worth making public even before the user has fully checked or digested it, provided its status is clearly declared. Its provenance should be fully disclosed, ideally including the prompts and responses that produced it. Special repositories for AI-generated mathematics, such as Hexagon [He], or a researcher's webpage or blog, would be more appropriate. Once the ownership culture has receded, such material could enter the common mathematical pool, available for anyone to check, understand, improve, or ignore.

We should also make more room for contributions that do not culminate in a theorem: fruitful definitions, conjectures, research programs, illuminating examples, and explanations of failed approaches. What matters is the creative potential of the idea, even if it is not a complete result.

Finally, publication need not be confined to the traditional paper format. Recorded talks can convey motivation and perspective,[12] while interactive companions can answer questions and expand compressed arguments.[13] Publication should evolve from a passive record of finished results into a vibrant infrastructure for navigation, understanding, and further development of mathematics.

5.5 A shared mathematical culture

Mathematical culture lives in people, not in documents. It is carried by seminars, conversations, teaching, and the experience of thinking together. We learn not only proofs, but perspectives, motivations, and lessons from failed approaches that may never be written down. This shared understanding is a vital part of mathematics.

For this reason, collaboration should take precedence over competition. In PRIMES, MIT's research program for high-school students, which we created in 2010 [PRIMES, EGK], we have always emphasized collaboration over competition, and now this matters more than ever. Mathematicians with different backgrounds can help one another understand unfamiliar ideas, test each other's intuition, and see connections that none would find alone. Mathematical understanding grows when it is shared.

Seminars and conferences should increasingly reflect cooperative mode. A speaker does not always have to present their latest result. Explaining an important development, comparing viewpoints, or clarifying a difficult subject may be just as valuable. Longer discussions and working sessions can foster genuine common understanding better than a sequence of compressed announcements.

We should also make this side of mathematics more visible outside our community. Public lectures and accessible writing can show that mathematics is more than a collection of solved problems: it is a way of understanding the world and thinking together. AI-assisted

[12] The video journal *Mathematical Discourse* offers one example [MD].

[13] Miao and collaborators propose that research papers could become interactive AI agents, functioning as virtual corresponding authors [MDZPZ].

exposition may help open this culture to more people [Gi]. As AI expands the mathematical horizons, an important task will be to sustain interest for mathematics in a wider community.

5.6 AI-vegan mathematicians

A more open and collaborative mathematical culture must also welcome colleagues who choose not to use AI. Max Weinreich introduced the term "AI-vegan mathematicians" for those who make this choice, whether for ethical reasons or because they prefer to work without AI [W]. He argues for a collective rejection of AI in mathematics on the grounds that its use threatens both mathematical practice and broader social values. This view is shared by the AI-free caucus of the Association for Human Mathematics [AHM].

There is some tension between this position and the tradition to use every available tool to extend and verify mathematical knowledge. But the more important issue is practical. A discipline-wide boycott seems unlikely to succeed. Our community is too large and diverse to act unanimously, and even if most mathematicians declined to use AI, anyone could still use AI tools to produce and release significant mathematical results. The future of the field therefore cannot possibly be AI-free.

Yet the concerns of AI-vegan mathematicians are serious, and their choice deserves respect, as does the choice of those who use AI extensively. At a time of unusually sharp disagreement, we should make a special effort to preserve the friendly and cooperative character of the mathematical community.



In fact, the model we advocate places AI vegans on equal footing with AI omnivores. Intellectual agency does not require AI. It can be developed through books, lectures, seminars, conversations, independent thought, and sustained engagement with mathematics in the traditional way. Human exposition can also make AI-assisted mathematics accessible to mathematicians who choose not to interact with AI directly. What matters is the same in either case: knowledge, understanding, judgment, and vision.

The same point applies to mathematicians who lack access to the strongest models for economic or institutional reasons. Under the ownership culture, a system that rewards the quantity and quality of output could easily turn access to compute into a career advantage. A system centered instead on intellectual agency helps level the playing field: mathematicians

are judged by what they know, understand, and contribute to the mathematical culture, not by the power of the models available to them. It would not erase inequalities of resources altogether, but would allow full participation in mathematics without access to expensive AI models.

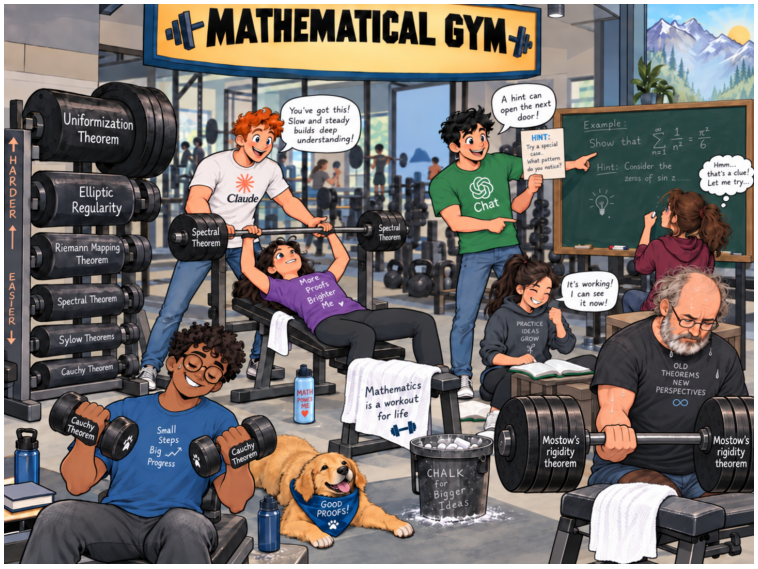
Preserving a healthy mathematical community through this transition will require tolerance from both sides. One should neither dismiss AI vegans and skeptics as backward nor label AI omnivores as intellectually or socially irresponsible. Collaborators should agree on what tools may be used and what material may be shared with them, but disagreement about AI should not become a test of whether someone belongs in mathematics.

6 How should mathematicians be trained?

If knowledge, understanding, and vision are to matter more, mathematical training should aim directly at developing them. Producing a strong mathematical text and becoming a strong mathematician will be very different things. AI may greatly accelerate the first; it cannot substitute for the second.

6.1 Learning with and without AI

Problem solving may become less valuable as professional output, but it will remain essential to becoming a mathematician. We learn by playing with examples, making mistakes, struggling with proofs, and finding our own explanations. Reading a theorem and closing the book to prove it ourselves is useful even when the proof is readily available. The same will remain true when the proof is only a prompt away. All of us, not only students, will still need this mathematical gym to keep our problem-solving muscles in shape.



AI therefore makes self-discipline more important than ever. Before asking for an answer, we should ask what we are trying to learn. Sometimes a quick explanation lets us move on

to deeper questions. Sometimes the struggle itself is what we need. The answer depends on the person and the purpose.[14]

There is a broader danger as well. AI makes it extraordinarily easy to move through mathematics while glossing over the details: accept an explanation that feels convincing, jump to the next idea, and gradually lose contact with the inner workings of the subject. Daniel Litt warns that mathematics will not end because AI solves too many problems, but it could end if mathematicians cease to engage deeply enough with mathematics to understand what is actually going on [Li2].

Used well, however, AI can make active learning far more effective. We can ask for a hint rather than a solution, an example to clarify an abstract notion, or a problem designed to test our understanding. But an explanation may seem clear before it has been truly absorbed. A better test is whether we can reconstruct the argument, apply the idea in a new setting, and explain it clearly to someone else. While the way we acquire mathematical knowledge may change, the standard for what it means to understand mathematics should not.

Discovery-based learning may therefore become especially valuable. A carefully designed sequence of problems lets students build a theory for themselves and experience the pleasure of discovery.[15] AI could help create and personalize such materials on a scale that was previously unfeasible. The goal is to help learners internalize mathematics, even when AI could carry them through it much faster.

6.2 Courses and examinations

AI also changes the role of the classroom. Students could study a lecture or text beforehand, with an AI tutor available for questions, and spend the class time working on problems in small groups with instructor's help.[16] Classroom sessions would then facilitate the most difficult parts of learning, and instructors would be able to directly monitor students' understanding.

Homework will remain very important, but a polished take-home solution will carry less weight as evidence of learning. As AI use becomes harder to detect, even supervised written examinations may need to be supplemented by in-person discussion of submitted solutions and oral examinations.

For instance, following the Eastern European model, students could receive a list of theoretical questions in advance, draw a selection of questions and a problem at the examination, prepare their answers, and then explain them to the instructor. Follow-up questions can then test the depth of understanding.

Such examinations take time and need thoughtful design. They should not become contests in speed, confidence, or fluency: preparation time, clear criteria, appropriate accommodations, and several opportunities to demonstrate understanding are important. Nor

[14] Thomas Koberda distinguishes productive cognitive offloading from delegating a task before the relevant competence has developed, and proposes both independent and AI-augmented modes of training [Ko]. Antieau's advice is: "Do not work faster than you can understand or effectively communicate" [An].

[15] Alekseev's book *Abel's Theorem in Problems and Solutions*, based on Arnold's lectures, is a beautiful example of this [A].

[16] Tanya Khovanova advocates trading the usual roles of lectures and homework [Kh].

is an oral examination totally immune to outside assistance. The aim is to obtain better evidence of subject mastery, not to build a perfect technological defense against dishonesty.

Some activities may explicitly permit AI, while others may require students to work without it. Both modes are valuable when their purpose is clear. Mathematical competitions can likewise continue as explicitly human activities governed by rules prohibiting outside assistance, much as chess competitions do.

AI may change how mathematics is taught and how students are assessed, but it should not change what mathematical education is trying to achieve. The tools may change radically; the goal remains to teach students to understand mathematics, explain it, and think mathematically for themselves.

6.3 Graduate study

Graduate education should shift some of its emphasis from early specialization and rapid publication toward broad knowledge, deep understanding, communication, and judgment. Students still need to master a substantial area, but there will be less reason to narrow their interests prematurely merely to build a publication record. They should also learn enough mathematics beyond their specialty to recognize connections, formulate good questions, and move confidently into new territory. [PhdSu].

Faculty-led seminars, reading groups, and advanced courses can play a larger role in this training. Students should regularly explain mathematics to one another, compare viewpoints, and answer questions. Collaboration should be cultivated from the beginning. AI can help fill gaps in background and accelerate exploration, but presenting an idea at the blackboard and defending it in discussion forces the student to absorb mathematics.

Mentoring will become more important than ever. Students will need frequent conversations with advisers about what problems to pursue, what to learn, when to use AI, and whether it is facilitating or short-circuiting their intellectual development [PhdSu]. Mentoring should also extend beyond the adviser: advanced students and postdocs can guide younger students through unfamiliar subjects and research problems. This helps both sides. Explaining mathematics, suggesting questions, and following a mentee's progress deepen the mentor's own knowledge and judgment while building experience in teaching, collaboration, and mathematical leadership.

The dissertation should remain a substantial mathematical undertaking, but the document alone can no longer certify the student's mathematical level. What matters is the mathematician who has grown through the project. The student should fully understand the mathematics surrounding the thesis, explain its main ideas and motivations, compare alternative methods, and describe how any AI-assisted work was checked. The thesis need not contain the first proof of a particular statement; originality can also reside in ideas, methods, questions, connections, or synthesis [Ko, Gl, Li3, PhdSu].

Assessment should therefore rely much more on sustained mathematical interaction. Examiners can ask for examples, changes of hypotheses, comparisons with other methods, or possible next directions. Regular meetings with several faculty members can assess research plans and intellectual development along the way [PhdSu]. Seminars, teaching, mentoring, discussions, and the student's own writing provide a better record of mathematical growth than any single document can.

In particular, an unexpected AI solution to a student's thesis problem should not invalidate the intellectual effort already invested. The project can then shift to understanding the proof, extracting its ideas, extending them, or placing them in a broader context. The purpose of graduate school is not to keep a conjecture open long enough for a student to claim it. It is to raise a mathematician.

6.4 An AI research lab

These principles suggest new ways to organize mathematical research. One such model is a small AI research lab or workshop, led by a faculty member and open to students with some background in a common subject. Its goals would be to combine collaborative research with powerful AI, stimulate learning, and develop the ability to check and understand AI output. The resulting mathematics would be presented in student-written notes or joint papers and in talks by the participants.

The lab could operate as follows:

1. **Meet and think together.** At regular meetings, the participants brainstorm projects at the blackboard without using AI. They take turns recording the discussion and presenting ideas or results from their own notes.

2. **Ask AI to respond.** After each meeting, the faculty member uploads the cleaned-up notes to a frontier model and asks it to suggest questions, ideas, proofs, and possible objections. Its output goes through a few rounds of revisions with an AI refereeing agent before being sent to the students. These checks improve the material for discussion.

3. **Study the response.** Students read the output before the next meeting, with different participants assigned to examine different parts carefully. They check claims and references, work through the arguments, and prepare to explain what they have understood. At the meeting, they use their own written notes, not model responses, to lead the discussion.

4. **Write and communicate.** The students maintain a coherent mathematical text, distinct from the rough meeting notes and AI transcripts. They write it themselves and revise it using comments from one another, the faculty member, and AI. This text can develop into joint papers by the students, with the faculty member acting primarily as a mentor, and be presented in talks. Writing can continue after the organized meetings end.

Students are free to use AI between meetings. The idea, however, is that the lab's systematic use of AI takes place in just one round after each meeting, in response to human discussion. This leaves time to think, learn, and write. It also pools access to a strong model through the faculty member's account, rather than making participation depend on each student's budget.

This design can be adapted to graduate, undergraduate, and even high-school research by varying the preparation required and the scope of the projects. Its success should be measured both by the mathematics accomplished and by the mathematical growth of the

participants. The aim is to use AI to produce better mathematics and stronger mathematicians.

7 Advice for young mathematicians

This brings us to the main question: should young people who love mathematics pursue it as a career today? Our answer is **yes**. AI makes the future of the profession less predictable, but it also opens extraordinary opportunities to learn, explore, and understand mathematics.

Here is some specific advice.

- **Accept fundamental uncertainty about the future.** No one knows what mathematics, or most other professions, will look like in ten years, or even in five. Build knowledge and skills that will remain valuable in many possible futures rather than organizing your life around the latest forecast about AI.
- **Learn broadly and deeply; follow your heart.** Pursue your interests across mathematics and resist specializing too early. Breadth will help you see connections between fields. At the same time, study some subjects deeply enough to achieve genuine mastery.
- **Put collaboration ahead of competition.** Find people with whom you enjoy thinking. Ask questions, join seminars, explain what you understand, and do not be shy to speak up when you are confused. Helping one another understand mathematics will matter more than racing to produce another paper.
- **Cultivate your intellectual agency, with or without AI.** If you are comfortable with these tools, learn to use powerful models and, more importantly, to understand and judge what they produce. If you prefer not to use them, build your understanding by other means. Either way, keep solving problems, asking questions, writing explanations, and testing what you have truly learned.
- **Build your career plans around your strengths and aspirations, not anxiety.** Talk to your advisers, learn about academic and nonacademic careers, and keep several paths open. No one can promise an academic position, but abandoning a subject you love for another supposedly "safe" profession is hardly a guarantee of security in the age of AI.

You do not have to be the best mathematician in the world, or better than the machines, to have a rich mathematical life. There is no race with AI to win. What matters is understanding mathematics, helping others understand it, and pushing human understanding into places it has never reached.

Humanity will soon know far more mathematics than ever before and apply it in ways we cannot yet imagine. There may never have been a more exciting time to begin.

8 The epilogue

In this essay, we have shared our vision of mathematics in the age of artificial intelligence. It is only one of many viewpoints in the community, and the misgivings of many of our colleagues, including the grave concerns raised by AI-vegan mathematicians, deserve to be taken seriously. We have been given an extraordinary truth-finding tool, but it comes at a heavy cost.

In one important sense, however, the question of whether to choose this bargain is now moot. AI is here to stay, and we cannot proceed as if it does not exist. What remains in our power is how we respond: what we choose to value, how we train young mathematicians, and what kind of culture we build around this new tool. Rather than trying to salvage the old order, we should preserve what is essential – curiosity, knowledge, understanding, intellectual agency, and the joy of doing and sharing mathematics – as we open our minds to the vast and thrilling mathematical world that we can now explore.

Acknowledgments

The authors thank Shaoyun Bai, Henry Cohn, Larry Guth, Daniel Litt, and Chelsea Walton for useful discussions and comments. ChatGPT was used to improve the exposition of our ideas.

References

[AGMAI] Advisory Group on Mathematics and Artificial Intelligence, agmai.org/.

[A] V. B. Alekseev, *Abel's Theorem in Problems and Solutions: Based on the Lectures of Professor V. I. Arnold*, Kluwer Academic Publishers, Dordrecht, 2004, doi.org/10.1007/1-4020-2187-9.

[An] B. Antieau, "Fast math/slow math," guest post, *What's new*, 15 September 2026, terrytao.wordpress.com/2026/09/15/fast-math-slow-math/.

[AHM] Association for Human Mathematics, www.ahmath.org/.

[B] D. Bessis, "The fall of the theorem economy," 21 April 2026, davidbessis.substack.com/p/the-fall-of-the-theorem-economy.

[Ca] F. Calegari, "Ways to improve Mathematics (an introduction)," *Persiflage*, 17 September 2026, with comments, galoisrepresentations.org/2026/09/17/ways-to-improve-mathematics-an-introduction/.

[Co] H. Cohn, "The technical debt of AI-generated mathematics," guest post, *What's new*, 15 September 2026, terrytao.wordpress.com/2026/09/15/the-technical-debt-of-ai-generated-mathematics/.

[EGK] P. Etingof, S. Gerovitch, T, Khovanova, Mathematical Research in High School: The PRIMES Experience, www.ams.org/notices/201508/rnoti-p910.pdf, Notices of the AMS, September 2015, p. 910-918.

[Gi] N. Giansiracusa, "Let the Diners Into the Kitchen," guest post, *What's new*, 16 September 2026, terrytao.wordpress.com/2026/09/16/let-the-diners-into-the-kitchen/.

[Gl] D. Glickenstein, "Mathematics Graduate Training in the Age of AI," 17 September 2026, arXiv:2609.21132, arxiv.org/abs/2609.21132.

[Go] T. Gowers, "Why I didn't sign the Fields medallists' letter," guest post, *What's new*, 17 September 2026, terrytao.wordpress.com/2026/09/17/why-i-didnt-sign-the-fields-medallists-letter/.

[H] J. Howlett, "If AI can do math, what's the point of mathematicians?", *Scientific American*, 10 September 2026 (including comments by Geordie Williamson), www.scientificamerican.com/article/mathematicians-confront-the-ai-apocalypse/.

[He] Hexagon, hexagonmath.org.

[Kh] T. Khovanova, "Swap Lectures with Homework," 18 September 2026, blog.tanyakhovanova.com/2026/09/swap-lectures-with-homework/.

[Ko] T. Koberda, "Training Mathematicians in the Age of AI: Intellectual Agency, Cognitive Offloading, and the PhD Thesis," 23 September 2026, arXiv:2609.28140, arxiv.org/abs/2609.28140.

[Kra] B. Kra, "Deep theorems were scarce and difficult and so became an effective mechanism to identify deep thought. AI has broken this system," guest post, *What's new*, 13 September 2026, terrytao.wordpress.com/2026/09/13/deep-theorems-were-scarce-and-difficult-and-so-became-an-effective-mechanism-to-identify-deep-thought-ai-has-broken-this-system/.

[LD] *Leiden Declaration on Artificial Intelligence and Mathematics*, 2 June 2026, leidendeclaration.ai/.

[Li1] D. Litt, "Mathematics in the Library of Babel," 21 February 2026, www.daniellitt.com/blog/2026/2/20/mathematics-in-the-library-of-babel/.

[Li2] D. Litt, "The end of mathematics", 11 August 2026, www.daniellitt.com/blog/2026/8/11/the-end-of-mathematics/.

[Li3] D. Litt, "A beginning for mathematics," 13 September 2026, www.daniellitt.com/blog/2026/9/13/a-beginning-for-mathematics/.

[MD] *Mathematical Discourse*: A peer-reviewed video journal for mathematics research talks, www.mathematicaldiscourse.org/.

[MDZPZ] J. Miao, J. R. Davis, Y. Zhang, J. K. Pritchard, and J. Zou, "Reimagining research papers as interactive and reliable AI agents," *Nature*, published online 16 September 2026, doi.org/10.1038/s41586-026-11044-y.

[Pa] Palomar, registry of Lean-verified mathematics, palomar-registry.org/.

[PRIMES] PRIMES, Program for Research in Mathematics, Engineering and Science for High School Students, MIT, math.mit.edu/research/highschool/primes/.

[PhdSu] Report of Summit on PhD Math Education in the Age of AI, cmsa.fas.harvard.edu/media/2026/09/Summit-on-PhD-Math-Education-in-the-Age-of-AI.pdf.

[Sah] A. Sahai, "We're gonna need a lot more mathematicians," guest post, *What's new*, 24 September 2026, terrytao.wordpress.com/2026/09/24/were-gonna-need-a-lot-more-mathematicians/.

[San] G. Sanderson, "If math is more than proof, we need to better celebrate the rest of it," guest post, *What's new*, 18 September 2026, terrytao.wordpress.com/2026/09/18/if-math-is-more-than-proof-we-need-to-better-celebrate-the-rest-of-it/.

[Se] J. P. Serre's talk on his 100th birthday, September 15, 2026, *Plaisir des mathématiques*, www.youtube.com/watch?v=tNtoTzGltak&list=PLMnSqzwPUcEI&index=4; English translation gist.github.com/mbintz/8cb96beaebc4713246fe93b5372e3c0a.

[SM] "A Severe Misalignment of AI in Mathematics," open letter initially signed by 25 Fields medalists, 11 September 2026, mathandai.org/.

[T] W. P. Thurston, "On proof and progress in mathematics," *Bull. Amer. Math. Soc. (N.S.)* **30** (1994), 161–177, arxiv.org/abs/math/9404236.

[W] M. Weinreich, "The crisis of AI-generated mathematics," 2026, arXiv:2608.02859, arxiv.org/abs/2608.02859.