The Freedom to Value Mathematics Differently

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Abstract. *The development of technology may change what is possible, but it does not have to determine what we choose to value. This essay offers some personal reflections on mathematical craftsmanship, understanding and intellectual traditions with an emphasis on their differences across fields. It considers how these differences may shape our attitudes toward new technologies and how individuals and communities have the freedom to determine their own value.*

One might reasonably think that if AI could produce genuinely good mathematics, we could appreciate it provided that mathematicians are willing to understand the results. It is also quite possible that conceptual development and mathematical judgment would remain particularly difficult for AI even as it becomes good at some kinds of problem solving, so that the community might naturally shift its values toward aspects where AI is less capable.

I find these considerations reasonable. But they also raise a philosophical question: How much should our mathematical values depend on what AI is capable of? The answer may be quite personal and may also vary across different fields of mathematics.

Perhaps discussions about mathematical values and AI need to be more specific to individual mathematical fields and traditions. Mathematics is often treated as a unified discipline, but different areas can have remarkably different intellectual cultures, sometimes perhaps as different as those of separate scientific disciplines. So it would not be surprising if different mathematical communities developed very different attitudes toward AI, even when faced with the same technological capabilities.

What Makes Mathematics Valuable?

There is a considerable diversity in what different areas of mathematics value. Some mathematical traditions place greater emphasis on obtaining concrete results, solving problems, and others emphasize more on conceptual understanding and the craftsmanship of mathematical discovery.

Even mathematical craftsmanship can take quite different forms. In structural commutative algebra, for example, much of the craftsmanship lies in developing an intimate understanding of mathematical objects, recognizing hidden structures and relationships. In analytic number theory, it may lie more in the delicate development and refinement of techniques to overcome difficult obstacles and obtain stronger results. Both require considerable effort and mathematical judgment, but they may place different emphasis on the process and outcome of mathematical work. These differences are not absolute, but they suggest that even the meaning of mathematical craftsmanship can vary across intellectual traditions.

What I find particularly interesting is that these different traditions may also lead to very different attitudes toward AI. The same technological development may be welcomed in one mathematical tradition but receive more objections in another. These differences need not come simply from the capabilities of AI, but may arise from different mathematical values and intellectual traditions which may be partly shaped by the different natures of mathematical craftsmanship.

So different mathematical traditions may reasonably develop different relationships with AI and naturally go in very different directions with very different attitudes about AI.

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But one point is that the community still has a lot of freedom to determine certain uniform values in terms of scientific practices. For example, mathematical communities have traditionally placed considerable importance on being the first to obtain a result. But when the subjects producing the first results are replaced with AI, they should be treated differently in a way that any subsequent human work should be recognized as the first regardless if any AI work exits. But the importance attached to being first is itself worth reconsidering. Mathematics is not simply a competition to solve problems first. Different proofs can offer different insights and open the way to further developments, regardless of their order of discovery.

Mathematics and Artistic Independence

Artists and musicians often have strong ideas about what makes their work valuable. They may choose to pursue their artistic ideals instead of following commercial trends, despite the uncertainty this implies. A similar attitude can be found in traditional craftsmanship. The differences are not about qualities. Machine-made instruments can even be superior in many ways, but instruments made by luthiers remain deeply valued as they carry particular traditions of craftsmanship that give them their own recognizable character and personality.

Could mathematics develop along similarly different paths? Perhaps some mathematical communities will increasingly embrace AI as a means of producing results, while others will continue to cherish the craftsmanship of mathematical discovery, preserving traditions of understanding and individual insight. Note that these differences have nothing to do with qualities themselves.

I am not sure how much these differences arise from the nature of the mathematics itself and how much from the intellectual cultures of individual fields. Perhaps AI will amplify differences in mathematical values that already exist across different mathematical communities.

But on a different view, maintaining intellectual independence can be difficult especially for people facing career uncertainty and competitive pressures. Some worry that AI will make academic competition even more unfair, but we're not convinced that the evaluation system is necessarily so vulnerable. Uncertainty existed long before AI. Academic careers have never depended entirely on mathematical ability or the quality of one's work. Advisors' recommendations, connections, research fashions, and luck have always mattered. Moreover, academic hiring considers more than publications, it already includes qualities that cannot simply be produced by AI. AI does not necessarily make the situation worse.

Of course, we should not ignore new concerns and difficulties arising from AI. There is no universal solution to these difficulties. But perhaps part of intellectual independence is accepting that doing what we value does not always bring the outcomes we hope for. This uncertainty is part of the risk of intellectual freedom.

Developing Mathematical Understanding

AI can still be very useful in many ways. Some expository uses may not be so different from searching the internet or consulting the literature, and AI can make such exploration more convenient. But when it comes to mathematical arguments themselves, we should be more cautious about the role we allow AI to play. I don't think we should ever adopt a research style in which humans provide only conceptual judgment while leaving the mathematical details to AI. At the very least, authors should be able to check and understand all the details themselves. But I am not even convinced that this is enough, especially when AI provides the main argument and humans only understand it afterwards. Sometimes finding a proof requires developing an understanding of the objects involved and even of many surrounding objects that goes far

beyond what is needed to follow the finished proof. Moreover, the process of discovery itself often leads to a deeper and richer understanding. Simply following a finished proof may provide some understanding, but it misses the process of developing understanding through discovery. There is a danger of losing this important part of mathematical understanding.

Moreover, understanding is itself difficult to judge. Knowing how much we really understand is a skill that develops with experience. Sometimes it takes being repeatedly challenged or reminded that we have not understood something to develop such judgment.

I remember fondly how my commutative algebra mentor could often look at a complicated proof and say that there was a much simpler argument once one understand what is really going on. I also learned from working with different professors that there are different ways of engaging with details to develop understanding. The finished proof can reveal a lot about how a mathematician understands their subject, and even have the signature character of a particular school. In a way, this is much like how instruments made in a particular luthier's workshop can have their own recognizable sound, character, and personality.

I also feel lucky to have inherited a distinctive mathematical perspective from my algebra mentor, which has given me directions to explore for years to come. I suppose such insights come from deep understanding and also have something to do with individual mathematical personalities. They develop through sustained engagement with mathematical details, including work that may not appear directly useful. Like a plant, it takes time and nourishment to grow. Trying to accelerate the process too much risks destroying what we cherish.



Nurturing Mathematical Insight

The boundary between human and AI involvement in mathematical research need not be uniform across different areas, given the considerable differences in their mathematical character and collective values. But where we draw these boundaries should be guided by what we value instead of simply by what others are doing. Our strong reservations about the use of AI in mathematical research come partly from our belief in the value of mathematical understanding and intellectual craftsmanship, and partly from our attachment to an intellectual tradition that we inherited and deeply cherish.

At the same time, we generally trust mathematicians who have developed mature mathematical judgment to decide how best to use these tools. We are not suggesting that most mathematicians use AI without understanding, and we recognize that many ways of using AI in research are

perfectly respectable, as long as one carefully considers where to draw the boundaries. We hope these reflections can serve as an invitation to reflect more deeply on what we value in our own mathematical fields and how those values shape our approaches to mathematics.

Continuing to Enjoy Mathematics

Perhaps the most important thing is that mathematics should remain something we genuinely enjoy doing.

Mathematical values don't need to remain unchanged forever. But changes should come from what we value and our intellectual judgment, rather than simply from technological capabilities or the practices of others.

Perhaps mathematicians can be a little stubborn about the things we find valuable. After all, we don't always need a better reason to pursue mathematics than that we find something worth understanding and enjoying.



Mathematical Stubbornness

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AI use note. *The comics were created as illustrations using Adobe Firefly, based on images and concepts provided by the author. AI use in the text was limited to built-in spelling and typo corrections.*