

Mathematics in the Age of AI

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I would like to begin with a few thoughts about anthropocentrism — the tendency to regard human beings as the centre of the universe, or as having some fundamentally privileged position in nature.

I am not going to discuss its moral aspects. But as a way of understanding objective reality, anthropocentrism has a rather poor historical record. For example, for centuries people believed that the Earth occupied the centre of the universe. Copernicus challenged this view. Later, Darwin challenged the belief that humans occupied a fundamentally separate position from other living organisms. Again and again, science has challenged our beliefs about human exceptionalism. Such beliefs often seem to be motivated more by human pride than by a desire to understand reality.

I think we are witnessing another example of this in discussions about artificial intelligence.

The human brain is a physical system that developed through biological evolution, using the materials available — cells, proteins, electrochemical processes. It is a remarkable product of evolution, but why should we assume that it is an optimal instrument for learning and reasoning? Or that comparable, perhaps superior, intelligence cannot be realized using completely different materials, such as chips and transistors?

After all, the human brain did not evolve for doing mathematics.

Another common argument is that AI may prove theorems, but it cannot really understand mathematics, appreciate mathematical beauty, or possess genuine intuition.

But what exactly do these statements mean? Do we have precise definitions of these concepts, even for humans? And why should we assume that whatever they mean, they must be exclusive to biological intelligence?

I am not claiming that AI necessarily possesses these qualities. I am questioning the grounds on which we declare that it cannot.

More generally, why should we assume that human mathematical thinking is the ultimate, or even a particularly natural, way of discovering mathematical truths?

Perhaps the most interesting possibility is not that AI will eventually learn to do mathematics as humans do, but that it will discover ways of doing mathematics that we would never have imagined.

This brings me to an analogy.

I sometimes think that the situation of mathematicians today resembles that of gold prospectors who have spent their lives searching for gold by hand along a beautiful river.

They enjoy their work, they have developed remarkable skills, and they take pride in their discoveries.

And suddenly, heavy mining machinery arrives.

Naturally, they may have mixed feelings about this development. But arguing that the machines cannot really appreciate the beauty of the river, or experience the joy of finding gold, seems rather beside the point.

Of course, the arrival of machinery raises very serious questions. Who owns the machines? Who controls them? What will happen to the prospectors? How will the gold be distributed?

These are important economic, social, and institutional questions. But they should not be confused with the question of whether the machines can find gold.

From this perspective, I see initiatives such as assembling groups of mathematicians at Princeton to respond to the AI revolution as a fairly conventional institutional strategy for managing technological disruption. Such initiatives may be useful, but they should not be confused with understanding the deeper nature of the transformation.

And there is one final point about this analogy.

The prospectors may love the river, but the gold does not care who discovers it.

Similarly, mathematical truths do not depend on who discovers them, or whether the discoverer is human.

Perhaps we have become accustomed to identifying mathematics with the activity of mathematicians. But these are not necessarily the same thing.

And perhaps the most interesting question is not how to preserve mathematics as a human profession in its present form, but **what mathematics itself might become when mathematical intelligence is no longer exclusively human.**

My personal expectation is that, in the not-too-distant future, AI agents will become the main driving force of mathematical research. They will not simply solve problems formulated by humans, but develop entirely new theories, mathematical languages, and conceptual frameworks.

The role of human mathematicians, even at the highest level, may change fundamentally. Instead of being the primary creators of new mathematics, we may increasingly find ourselves trying to understand, organize, and master mathematics discovered by AI. And it is quite possible that our ability to understand this mathematics will fall progressively behind the speed at which AI produces it.

But I do not see this as the end of mathematics, or even necessarily as the end of mathematics as a human intellectual activity.

After all, biologists do not create life (yet?). They study life, which exists independently of them, and their subject is no less fascinating because of that.

Perhaps mathematics will undergo a similar transformation. Instead of primarily creating mathematical theories ourselves, we may increasingly study a vast mathematical world explored and developed by other forms of intelligence.

Perhaps the future role of mathematicians will be not so much to discover mathematics as to understand mathematics that has already been discovered.

And I am not sure that this would make mathematics any less interesting.