Mathematics and Creative AI

Abstract

Artificial Intelligence (AI) is increasingly contributing to mathematics, from assisting in proof verification to uncovering patterns in complex structures. However, AI's role in creative problem-solving remains an open question. This paper examines the strengths and limitations of AI in mathematics, focusing on whether AI can engage in genuinely creative reasoning. We explore computational creativity through the lens of John McCarthy's definition—where creativity involves introducing new concepts not present in the problem statement—and the functional model of creative generation and evaluation.

We illustrate this with the Mutilated Chessboard Problem, a classic combinatorial challenge that requires conceptual insight. AI-generated responses to this problem, while well-formed, fail to demonstrate the underlying creative reasoning, highlighting AI's current limitations. The discussion extends to conceptual blending, a theory proposed by Turner and Fauconnier, which models human creativity as the integration of different conceptual spaces. While AI systems can merge data-driven insights, they still struggle with flexible abstraction and deep conceptual innovation.

Philosophically, AI's role in mathematical discovery raises critical questions about the nature of creativity and co-creativity between humans and machines. While AI excels at computation and pattern recognition, human mathematicians provide intuition, abstraction, and the ability to work with ambiguity. Rather than replacing human insight, AI offers a powerful collaborative tool for expanding mathematical knowledge. This paper provides suggestions for a balanced perspective where AI enhances rather than diminishes human creativity, emphasizing the complementary strengths of both.

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