Student use of AI as a study tool for mathematics

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AI tools, in particular Large Language Models, can be powerful tools for the study of mathematics if used appropriately to promote critical thinking. Using them in place of critical thinking has a detrimental effect on cognition and the learning process. This document outlines the appropriate use of LLMs as a study tool to promote learning and avoid inappropriate use.

Mathematical content of LLMs

The training data for LLMs extensively covers the standard undergraduate mathematics curriculum from US and other universities. It includes web documents, code with mathematical content, textbooks, online faculty-authored lecture notes, course materials and solutions to problem sets.

The training data for LLMs is not a curated, edited or verified account of these materials. LLMs inherit errors and misconceptions from their training data. Verification of AI output is a necessary step in using LLMs as a study tool.

Current LLMs are not more than 80% accurate on undergraduate mathematical questions. The primary way to offset the limitations of using LLMs as tools for mathematics is to use them in conjunction with Computer Algebra Systems or formal proof assistants, such as Lean. The Computer Algebra System WolframAlpha can be enabled in the paid version of ChatGPT and may auto-invoke it when the tool is enabled.

Verification of AI output

LLMs should not be used as 'calculators' or 'proof generators', as their output generally contains calculational, symbolic and logical errors. Output should be verified using critical thinking, instructor feedback, textbooks, lecture notes or a Computer Algebra System. You are responsible for the correctness of your own work. AI should not be the 'driver': verification of AI output requires mathematical understanding.

Drawbacks of student use of AI

If AI is used in place of critical thinking, you may become a passive consumer, not an active learner. Learning may be short-circuited by fast answers. Cognition may become suppressed, leading to misconceptions. You may lose fundamental skills and learn 'wrong' statements. Misuse of AI could constitute an academic integrity violation.

As a learning guide, you can use AI to:

Check your completed work, provide step-by-step hints for homework problems, generate a 'template' or 'worked example', find valid alternative solutions, generate new examples or practice tests and quizzes, help you understand for yourself where your solution went wrong, reinforce instructor feedback, translate math into executable code, format answers using LaTeX and answer questions without repercussions.