

# Generative AI in Computing Education

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All papers available at [brettbecker.com/publications](https://brettbecker.com/publications)

Back in the summer of 2021 we ran an experiment seeing how well Codex (GPT-3 with additional layer trained on “all” of the Python code in GitHub) could perform against real students on real student assessments in introductory programming (CS1).

## **The Robots Are Coming: Exploring the Implications of OpenAI Codex on Introductory Programming**

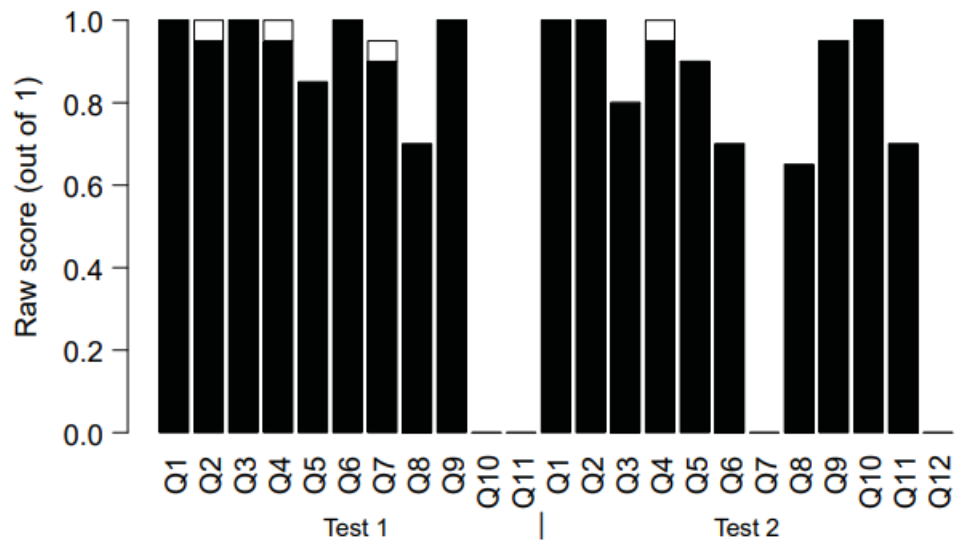
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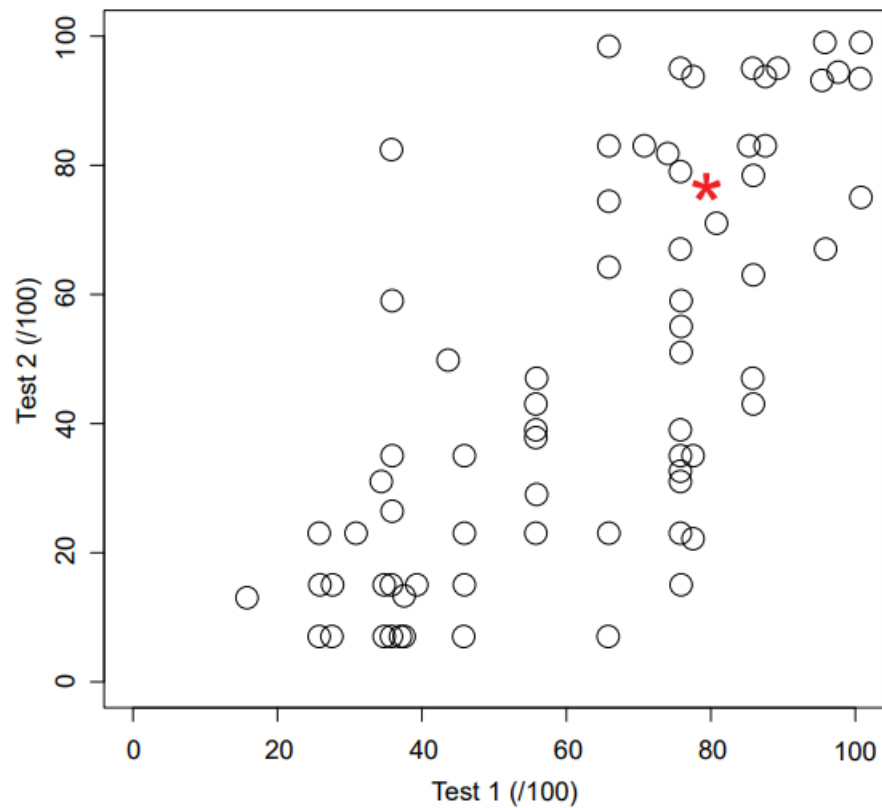
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**Figure 3: Raw score achieved by Codex on CS1 test problems (accumulating penalties applied for incorrect submissions; problems abandoned after 10 failing submissions). Empty caps on some bars indicate potential scores in the absence of trivial errors.**



**Figure 4: Student scores on invigilated tests (Test 1 and Test 2), with performance of Codex (plotted as red asterisk).**

December 2023: 52 pages of literature review (199 references total) student and instructor interviews, surveys, and a thorough-for-the-time treatment of ethical considerations, and benchmarking of GenAI. Also includes a “Student Guide” on GenAI including ethical implications that can be adapted for your students (in any module)

## **The Robots are Here: Navigating the Generative AI Revolution in Computing Education**

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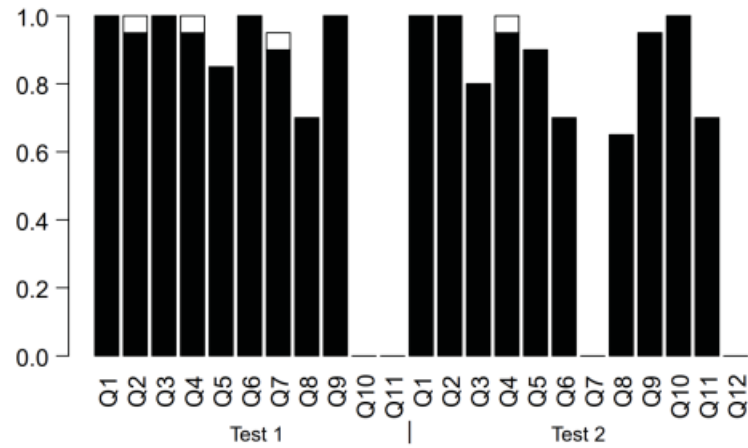
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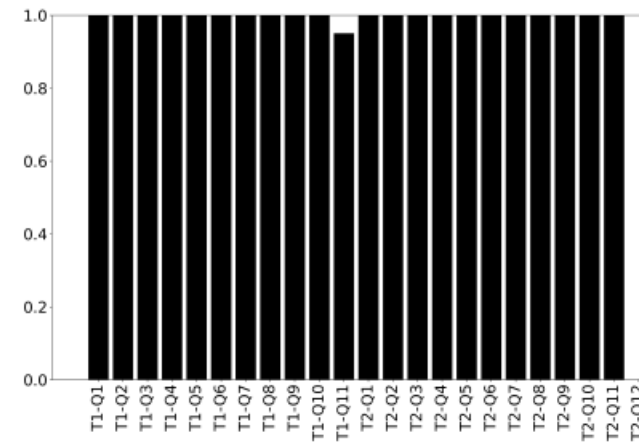
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Summer 2001 Codex (GPT-3)



The robots really were coming

Summer 2003 GPT-4



...and they really are here.

## Inherent Limitations of AI Fairness



Service Robot Anthropomorphism

Gaining Benefits from AI and Data Science

Computing Education in the Era of Generative AI

Talking about Large Language Models



RESEARCH AND ADVANCES

[Artificial Intelligence and Machine Learning](#)

## Computing Education in the Era of Generative AI

Computing educators and students face challenges and opportunities in adapting to LLMs capable of generating accurate source code from natural-language problem descriptions.

By Paul Denny, James Prather, Brett A. Becker, James Finnie-Ansley, Arto Hellas, Juho Leinonen, Andrew Luxton-Reilly, Brent N. Reeves, Eddie Antonio Santos, and Sami Sarsa

Posted Jan 18 2024

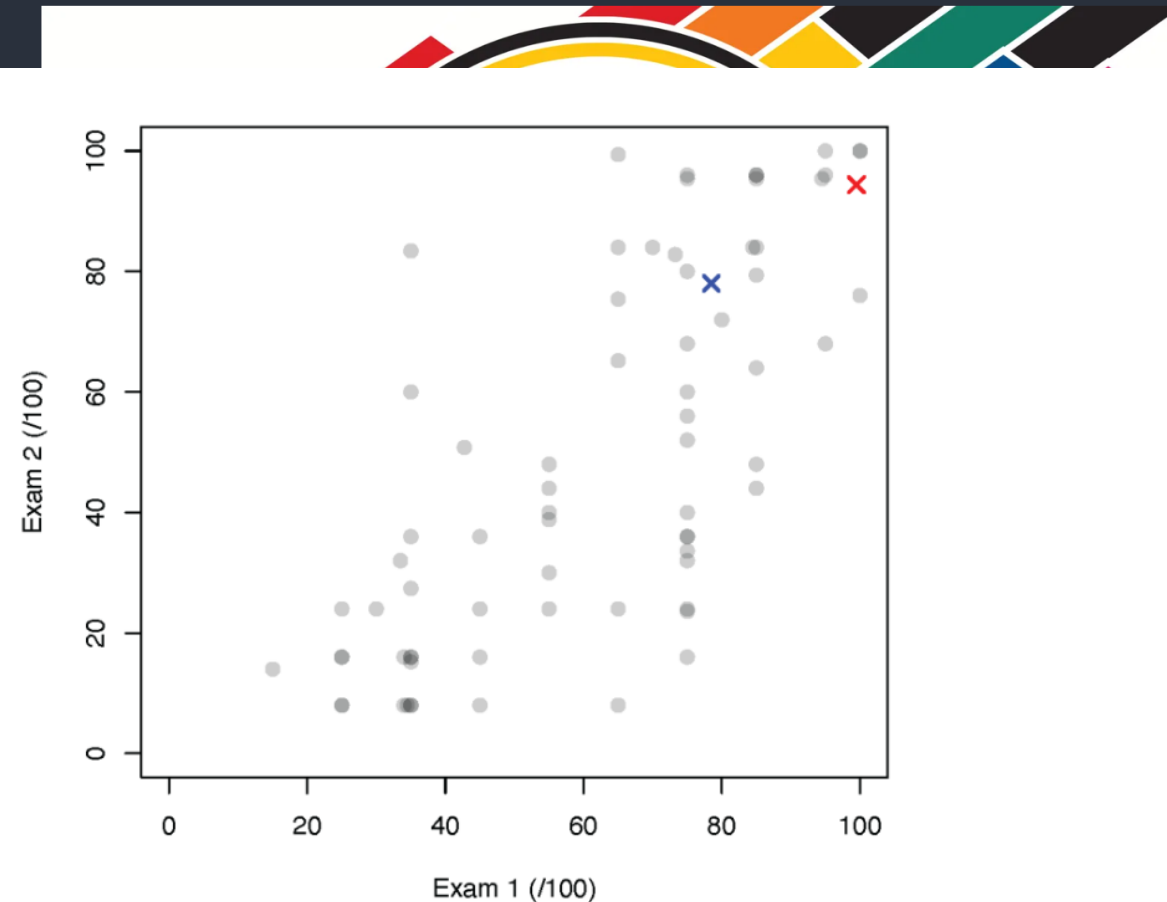


Figure 1. Student scores on Exam 1 and Exam 2, represented by circles. Codex's 2021 score is represented by the blue 'X'. GPT-4's 2023 score on the same questions is represented by the red 'X'.

# Using Large Language Models to Enhance Programming Error Messages

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## Always Provide Context: The Effects of Code Context on Programming Error Message Enhancement

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- Claim (99.99% confidence): Generative AI is better at programming than 99% of our students **at UCD** at the end of year 1
- ***Are we still teaching introductory programming the same way we were 2 years ago?***
- ***What should we do differently?***
- ***How can GenAI be leveraged for better learning?***
- ***How does this affect other courses?***
- ***What are the ethical implications?***



## Prompt Problems: A New Programming Exercise for the Generative AI Era

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- We have developed:
  - A new type of programming problem for education: **Prompt Problems**
  - A tool that can be used by students to practice Prompt Problems: **Promptly**
  - *Is this a good idea?*
  - *What else can be done in this arena?*

Not-bold claim (100.00% confidence): ***GenAI will cause problems and we need to deal with these***

Not-yet published work:

- GenAI helps good students get better and the poor get worse.
- There is real potential for an AI Divide in our programmes.
- ***What do we do about that?***

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Saarbrücken, March 28, 2024

**Proposal 202401085 for a Dagstuhl Seminar on *Generative AI in Programming Education***

Dear Professor Becker:

On behalf of the Scientific Directorate of Schloss Dagstuhl, I am pleased to inform you that your proposal "*Generative AI in Programming Education*" has been accepted as a *large* 5-day Dagstuhl Seminar (with approximately 40 participants). Congratulations!

We have scheduled your seminar as follows:

**Monday, July 28 to Friday, August 01, 2025**

Arrival is scheduled for the afternoon of Sunday, July 27, 2025.



**SCHLOSS DAGSTUHL**  
Leibniz-Zentrum für Informatik

**Prof. Raimund Seidel, Ph.D.**  
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