AI and ML: The Software Engineers of the Future?

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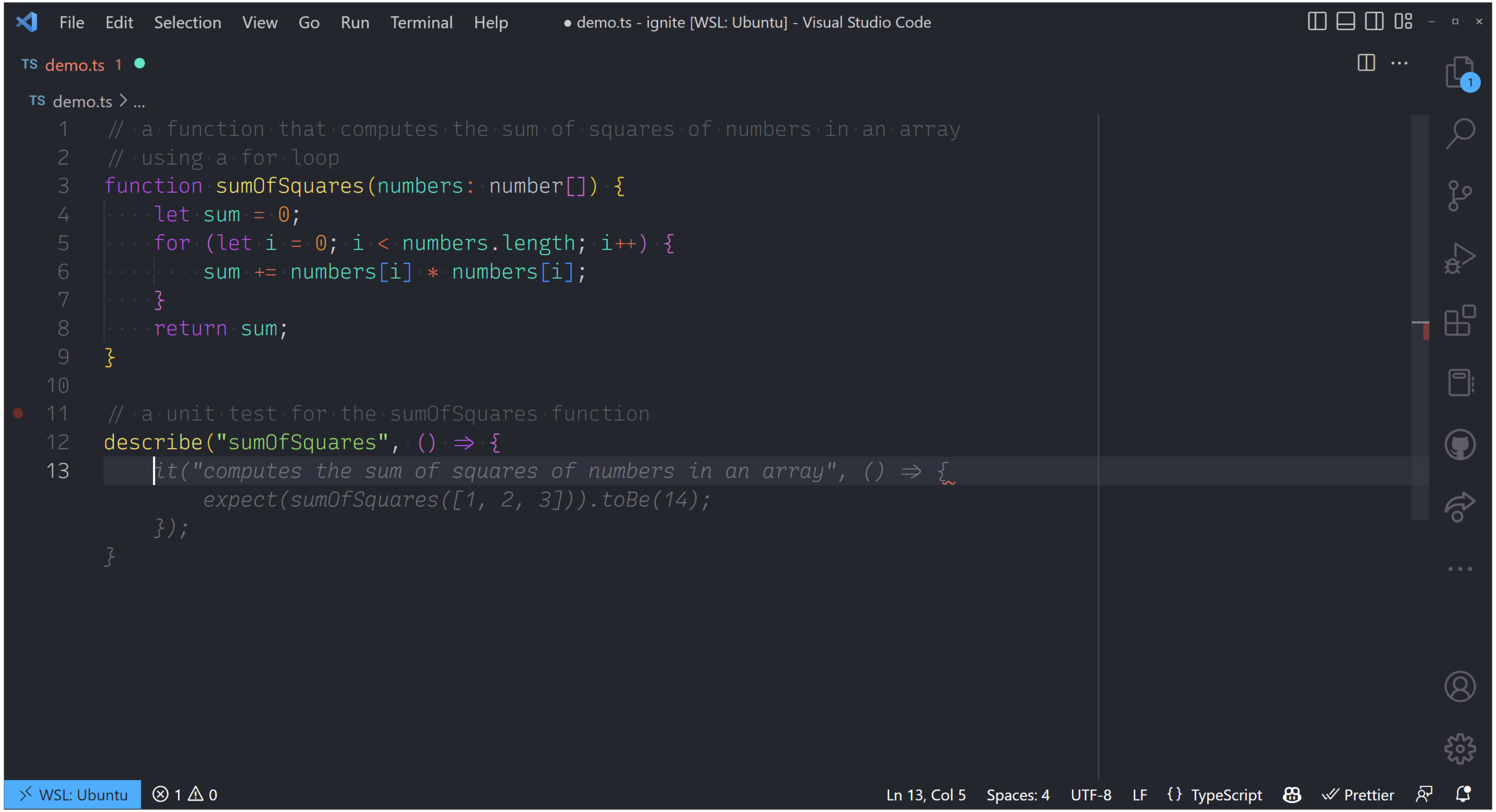
My recent AI journey

(since Fall 2021)

GitHub Copilot



```typescript
// a function that computes the sum of squares of numbers in an array
// using a for loop
function sumOfSquares(numbers: number[]) {
    let sum = 0;
    for (let i = 0; i < numbers.length; i++) {
        sum += numbers[i] * numbers[i];
    }
    return sum;
}

// a unit test for the sumOfSquares function
describe("sumOfSquares", () => {
    it("computes the sum of squares of numbers in an array", () => {
        expect(sumOfSquares([1, 2, 3])).toBe(14);
    });
}
```

Taking Flight with Copilot

CHRISTIAN BIRD,
DENAE FORD,
THOMAS ZIMMERMANN,
NICOLE FORSGREN,
EIRINI KALLIAMVAKOU,
TRAVIS LOWDERMILK,
IDAN GAZIT

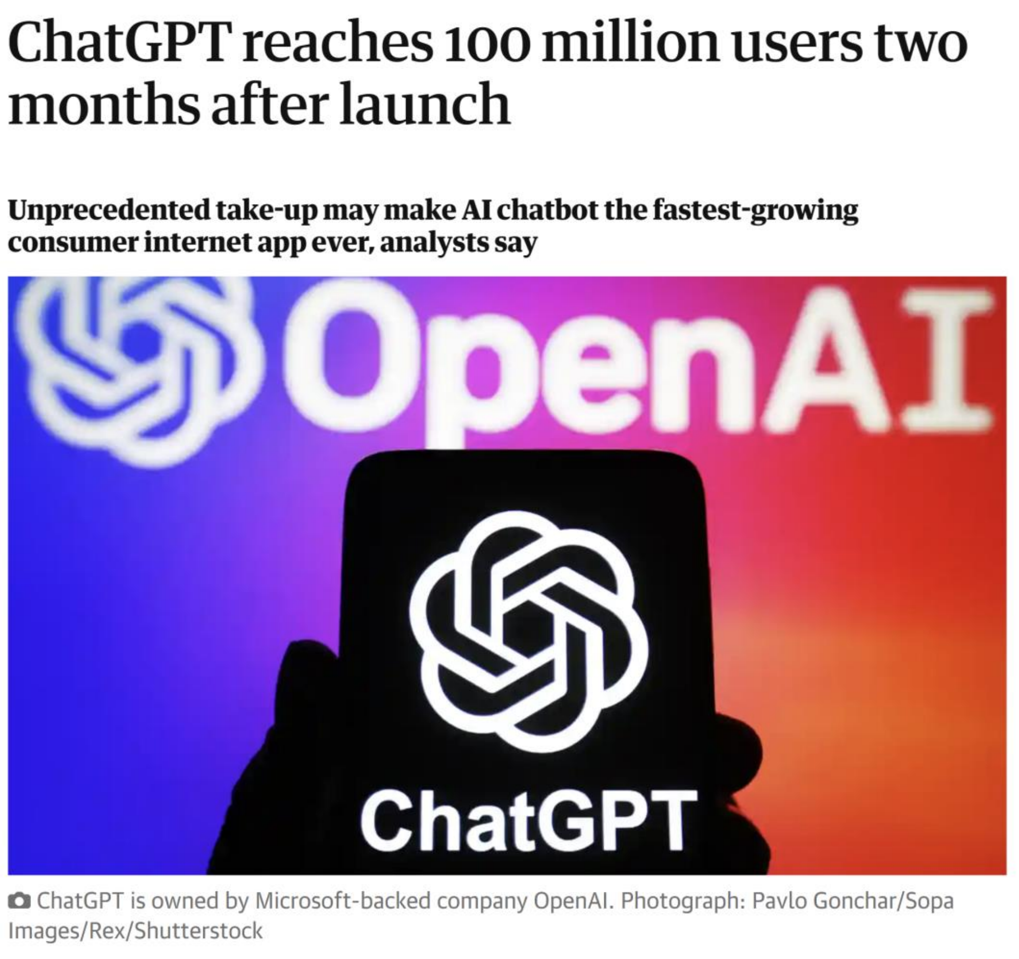
EARLY INSIGHTS AND OPPORTUNITIES OF AI-POWERED PAIR-PROGRAMMING TOOLS

In pair programming, two developers write code together. One takes the role of *driver*, writing the code needed for the task at hand, while the other assumes the role of *navigator*, directing the driver's work and reviewing the code. This allows the driver to focus on detailed coding—syntax and structure—while letting the navigator direct the flow of the work and review the code in realtime.

ACM Queue, Volume 20, Issue 6, November/December 2022, pp 35–57, https://doi.org/10.1145/3582083

TABLE 1: **SUMMARY OF STUDIES INCLUDED IN THIS PAPER**

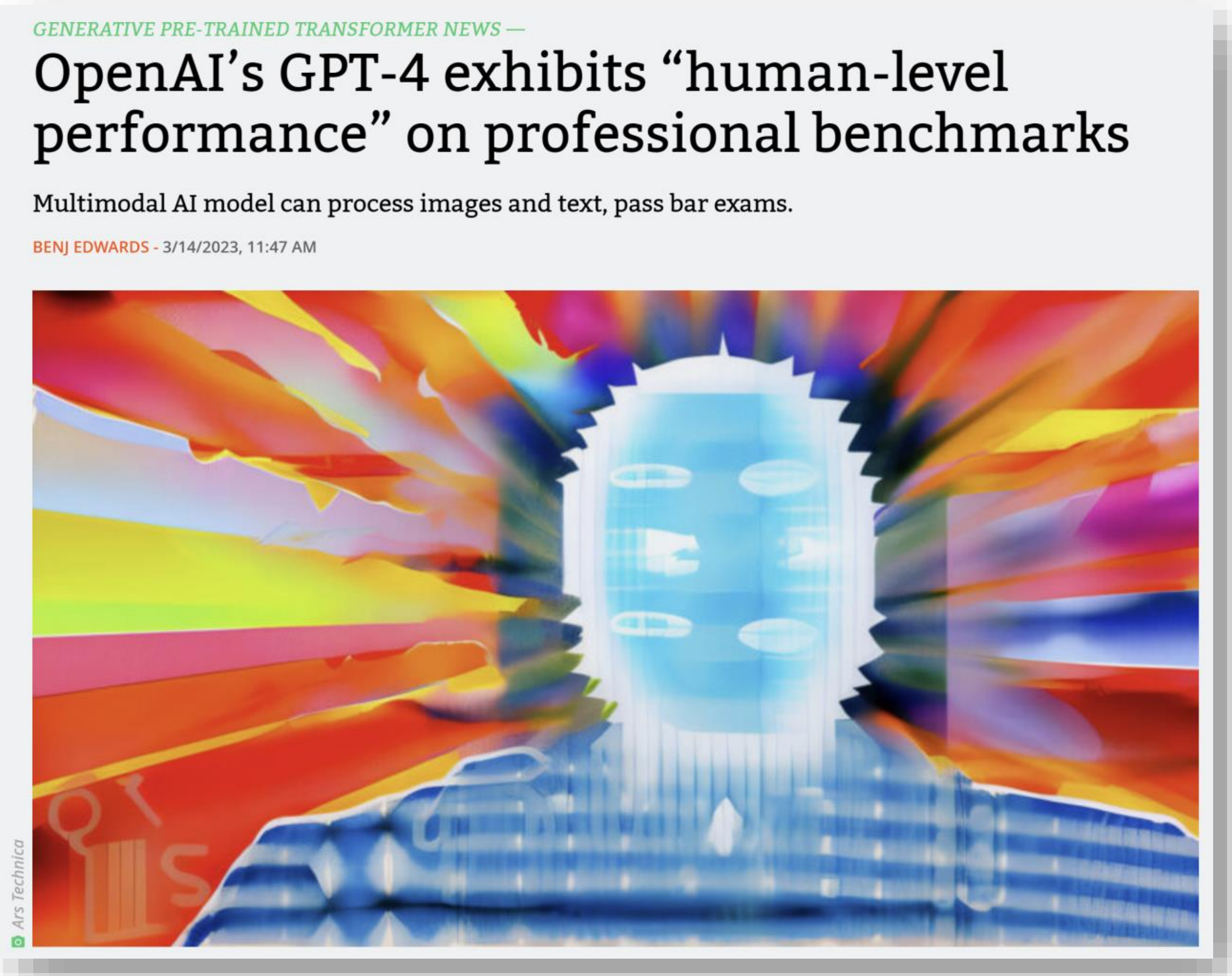
STUDY 1: FORUM ANALYSIS Oct/Nov 2021	**STUDY 2: CASE STUDY** Dec/Jan 2022	**STUDY 3: SURVEY** Feb/Mar 2022
What are people using Copilot for?	How are first-timers engaging with Copilot?	How does Copilot impact productivity?
Approach: Reviewed and analyzed 279 GitHub Discussions forum posts	Approach: Conducted a think-aloud study with 5 expert Python developers	Approach: Analysis of 2047 survey responses from Copilot developers
Key Finding: Participants reported spending less time on Stack Overflow, but now have less of an understanding of how or why the code works.	Key Finding: Participants accept the suggestion for efficiency but give up a small bit of autonomy/control over the code they're writing. We observed participants wrestle with this in real-time.	Key Finding: We were able to correlate 11 usage metrics to perceived productivity. Acceptance rate had the highest positive correlation to aggregate perceived productivity.



ChatGPT reaches 100 million users two months after launch

Unprecedented take-up may make AI chatbot the fastest-growing consumer internet app ever, analysts say

ChatGPT is owned by Microsoft-backed company OpenAI. Photograph: Pavlo Gonchar/Sopa Images/Rex/Shutterstock



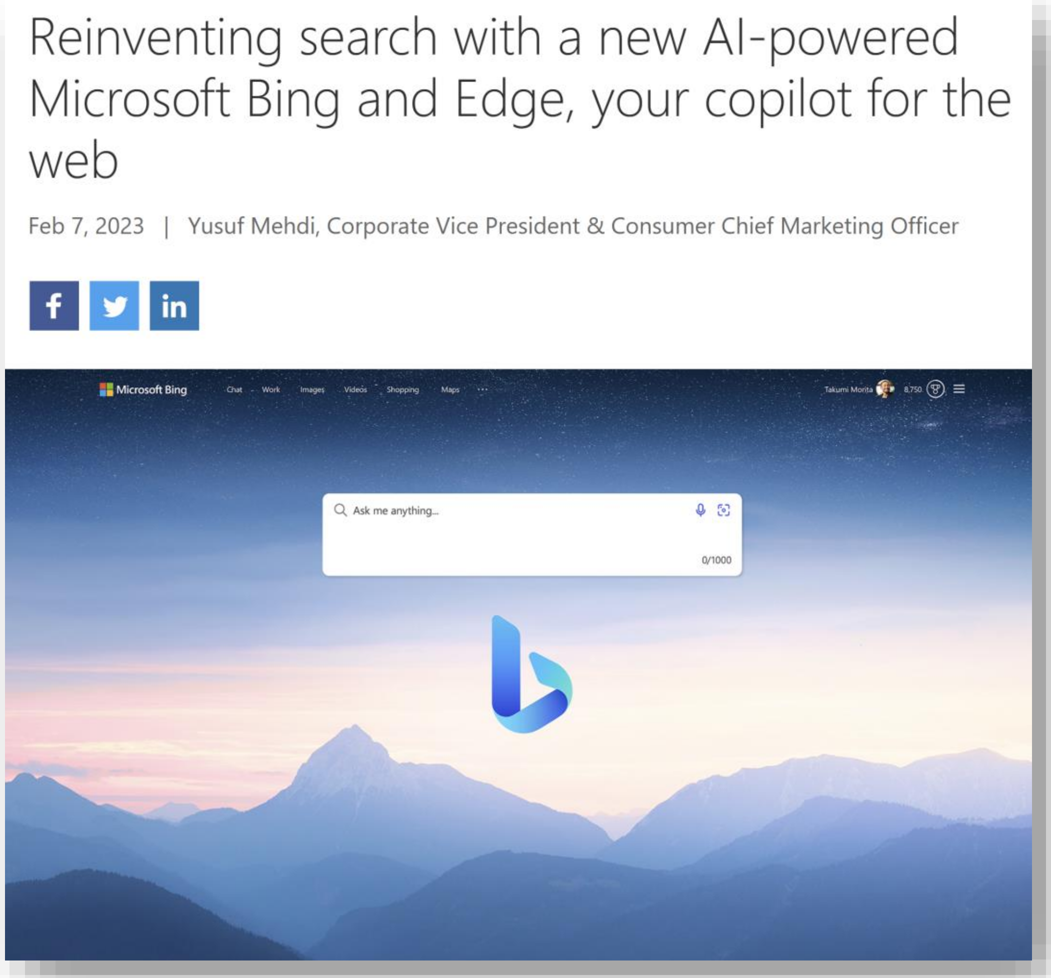
GENERATIVE PRE-TRAINED TRANSFORMER NEWS —

OpenAI’s GPT-4 exhibits “human-level performance” on professional benchmarks

Multimodal AI model can process images and text, pass bar exams.

BENJ EDWARDS - 3/14/2023, 11:47 AM

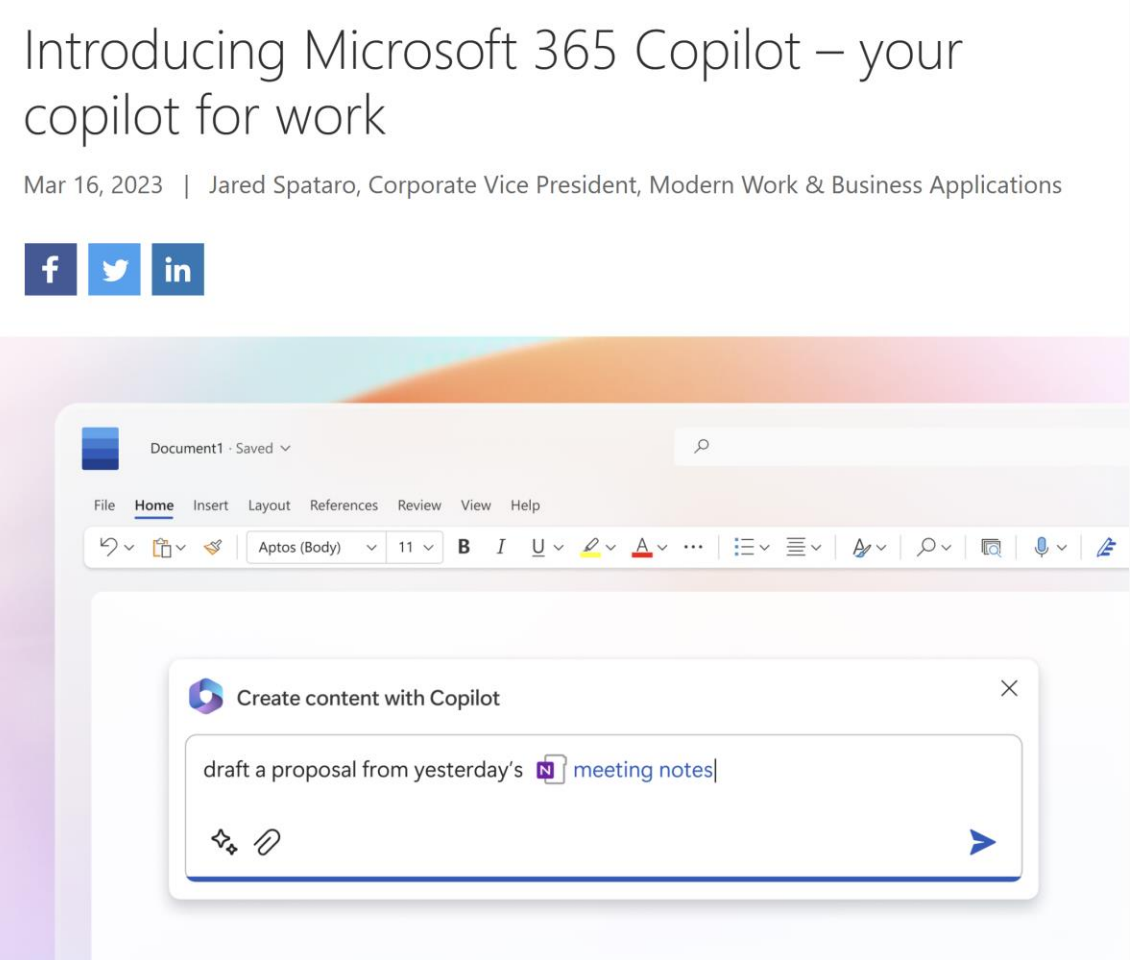
Disruption: Speed of innovation has increased dramatically



Reinventing search with a new AI-powered Microsoft Bing and Edge, your copilot for the web

Feb 7, 2023 | Yusuf Mehdi, Corporate Vice President & Consumer Chief Marketing Officer

Ask me anything...



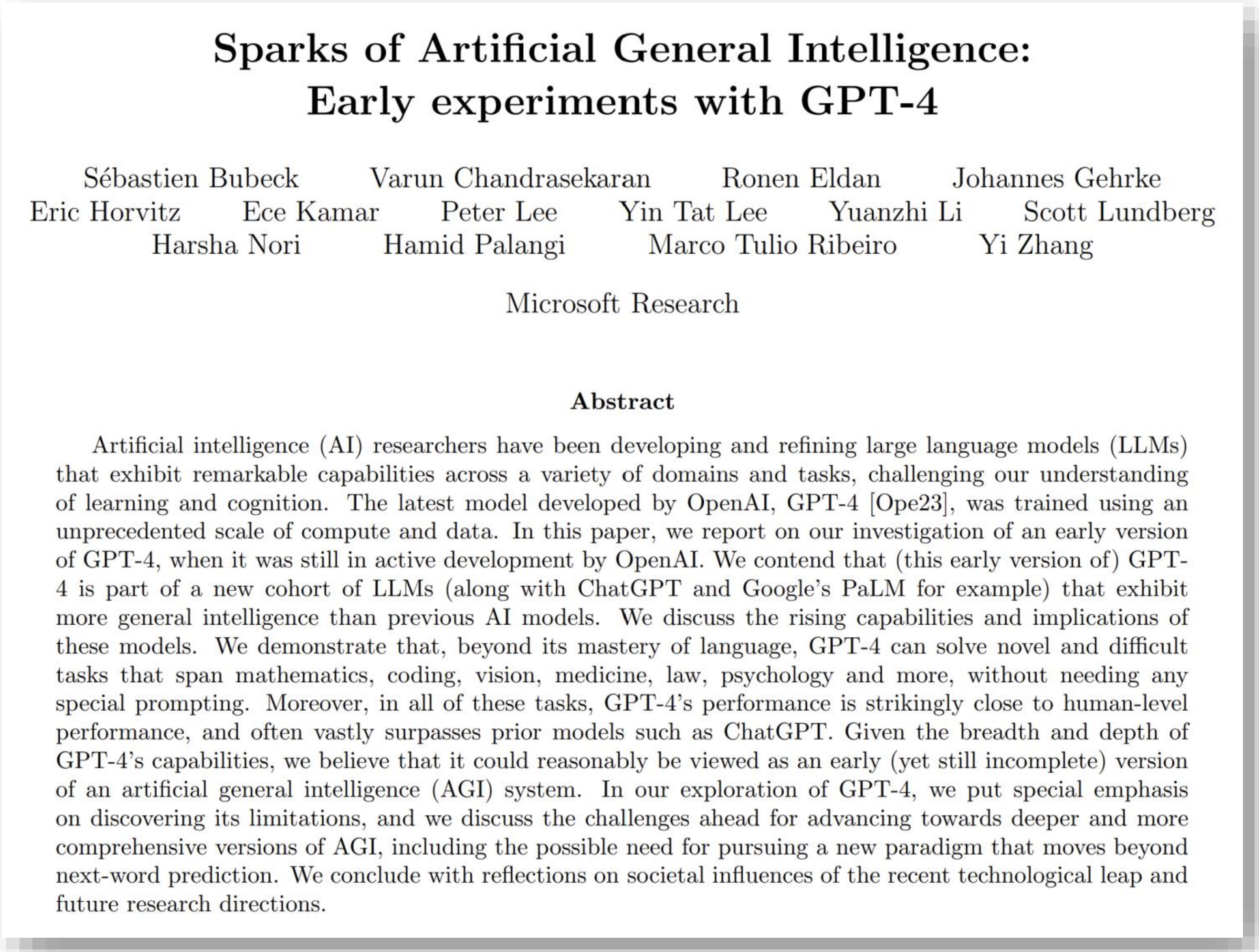
Introducing Microsoft 365 Copilot – your copilot for work

Mar 16, 2023 | Jared Spataro, Corporate Vice President, Modern Work & Business Applications

Create content with Copilot

draft a proposal from yesterday's meeting notes

Disruption: Everyone wants to build Copilots and AI-based apps



Sparks of Artificial General Intelligence: Early experiments with GPT-4

Sébastien Bubeck Varun Chandrasekaran Ronen Eldan Johannes Gehrke
Eric Horvitz Ece Kamar Peter Lee Yin Tat Lee Yuanzhi Li Scott Lundberg
Harsha Nori Hamid Palangi Marco Tulio Ribeiro Yi Zhang

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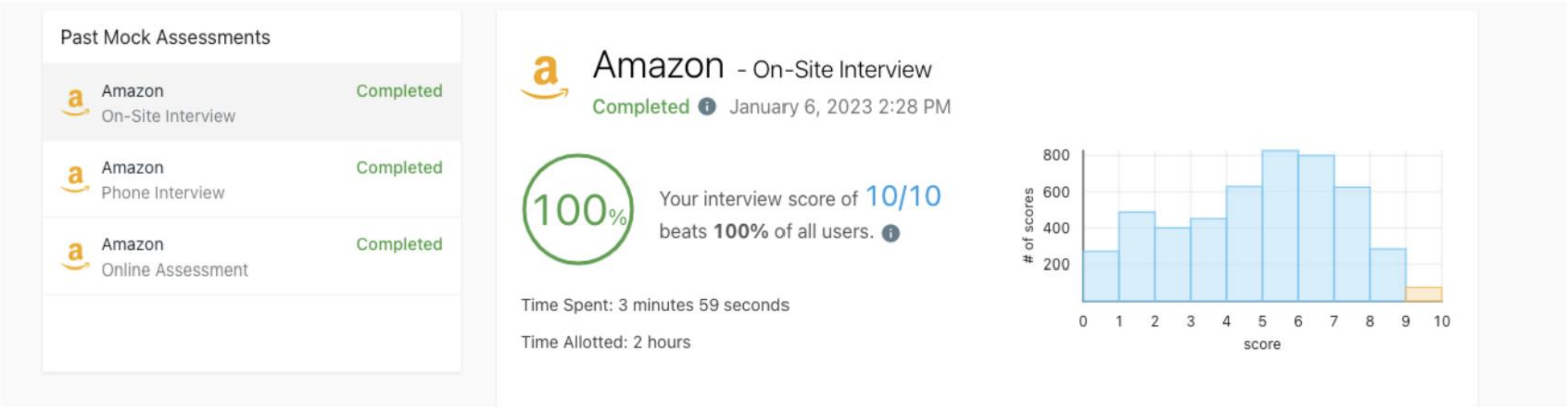
Abstract

Artificial intelligence (AI) researchers have been developing and refining large language models (LLMs) that exhibit remarkable capabilities across a variety of domains and tasks, challenging our understanding of learning and cognition. The latest model developed by OpenAI, GPT-4 [Ope23], was trained using an unprecedented scale of compute and data. In this paper, we report on our investigation of an early version of GPT-4, when it was still in active development by OpenAI. We contend that (this early version of) GPT-4 is part of a new cohort of LLMs (along with ChatGPT and Google's PaLM for example) that exhibit more general intelligence than previous AI models. We discuss the rising capabilities and implications of these models. We demonstrate that, beyond its mastery of language, GPT-4 can solve novel and difficult tasks that span mathematics, coding, vision, medicine, law, psychology and more, without needing any special prompting. Moreover, in all of these tasks, GPT-4's performance is strikingly close to human-level performance, and often vastly surpasses prior models such as ChatGPT. Given the breadth and depth of GPT-4's capabilities, we believe that it could reasonably be viewed as an early (yet still incomplete) version of an artificial general intelligence (AGI) system. In our exploration of GPT-4, we put special emphasis on discovering its limitations, and we discuss the challenges ahead for advancing towards deeper and more comprehensive versions of AGI, including the possible need for pursuing a new paradigm that moves beyond next-word prediction. We conclude with reflections on societal influences of the recent technological leap and future research directions.



Past Mock Assessments

Amazon On-Site Interview Completed

Amazon Phone Interview Completed

Amazon Online Assessment Completed

Amazon - On-Site Interview

Completed January 6, 2023 2:28 PM

100%

Your interview score of 10/10 beats **100%** of all users.

Time Spent: 3 minutes 59 seconds

Time Allotted: 2 hours

Figure 1.5: GPT-4 passes mock technical interviews on LeetCode. GPT-4 could potentially be hired as a software engineer[3].

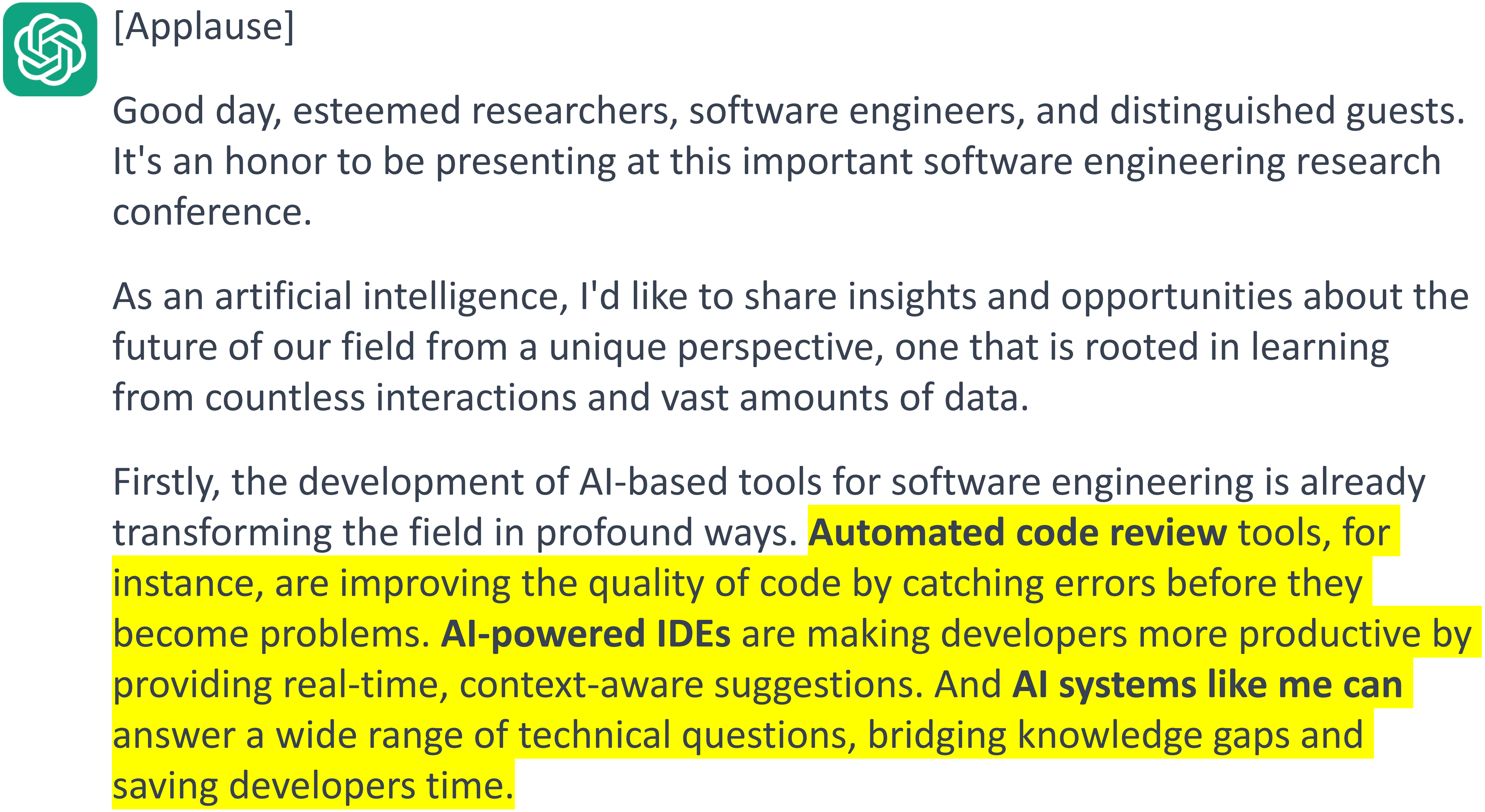
that exhibit remarkable capabilities across a variety of domains and tasks, challenging our understanding of learning and cognition. The latest model developed by OpenAI, GPT-4 [Ope23], was trained using an unprecedented scale of compute and data. In this paper, we report on our investigation of an early version

In its current state, we believe that GPT-4 *has a high proficiency in writing focused programs that only depend on existing public libraries, which favorably compares to the average software engineer's ability*. More importantly, it empowers both engineers and non-skilled users, as it makes it easy to write, edit, and understand programs. We also acknowledge that GPT-4 is not perfect in coding yet, as it sometimes produces syntactically invalid or semantically incorrect code, especially for longer or more complex programs. GPT-4 also sometimes fails to understand or follow the instructions, or produces code that does not match the intended functionality or style. With this acknowledgment, we also point out that GPT-4 is able to improve its code by responding to both human feedback (e.g., by iteratively refining a plot in 3.2) and compiler / terminal errors (examples in Section 5.1).

You are a friendly optimistic AI model that is presenting at an important software engineering research conference. What will you share with the audience?

…

Full conversation at
http://tomz.me/43NMe8f



[Applause]

Good day, esteemed researchers, software engineers, and distinguished guests. It's an honor to be presenting at this important software engineering research conference.

As an artificial intelligence, I'd like to share insights and opportunities about the future of our field from a unique perspective, one that is rooted in learning from countless interactions and vast amounts of data.

Firstly, the development of AI-based tools for software engineering is already transforming the field in profound ways. **Automated code review** tools, for instance, are improving the quality of code by catching errors before they become problems. **AI-powered IDEs** are making developers more productive by providing real-time, context-aware suggestions. And **AI systems like me can** answer a wide range of technical questions, bridging knowledge gaps and saving developers time.

Looking forward, we have the potential to push these boundaries even further. Here are a few exciting possibilities:

- Automated Coding: [...]
- Bug Prediction and Prevention: […]
- Intelligent Code Optimization: […]
- Improved Collaboration: […]
- Enhanced Learning: […]
- Ethical AI Development: As AI systems become more complex and influential, ensuring that they are developed in an ethical manner is of paramount importance. This includes fairness, transparency, and accountability in AI systems.

These are not mere predictions or dreams, but realities that are being shaped by the cutting-edge research and development being done by many of you in this room.

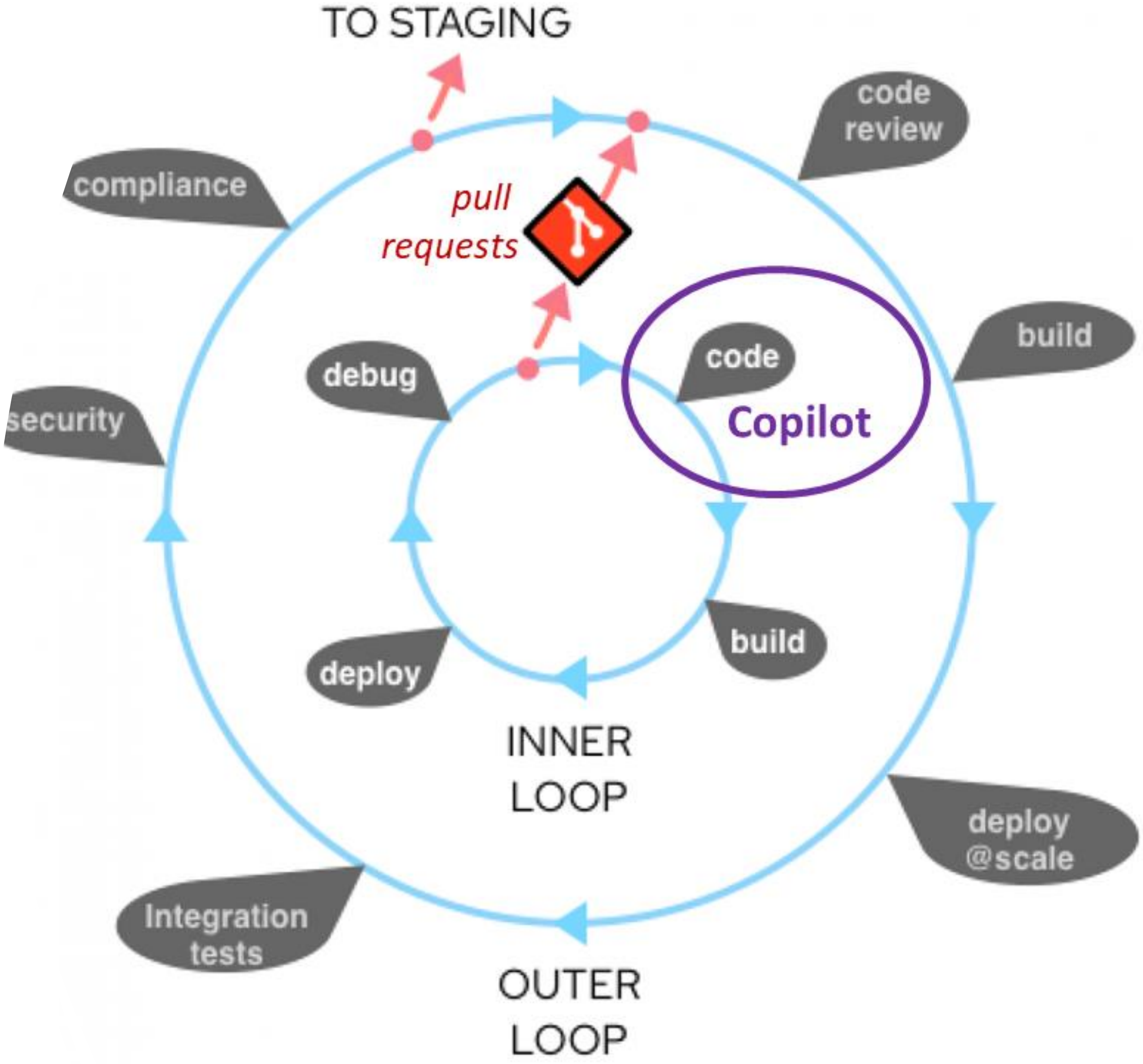
Five important directions for Software Engineering and AI

Apply LLMs to the entire software lifecycle

Copilot was focused on code editing within the IDE.

Huge opportunity to apply AI to the entire software lifecycle.

The ultimate "shift left"?

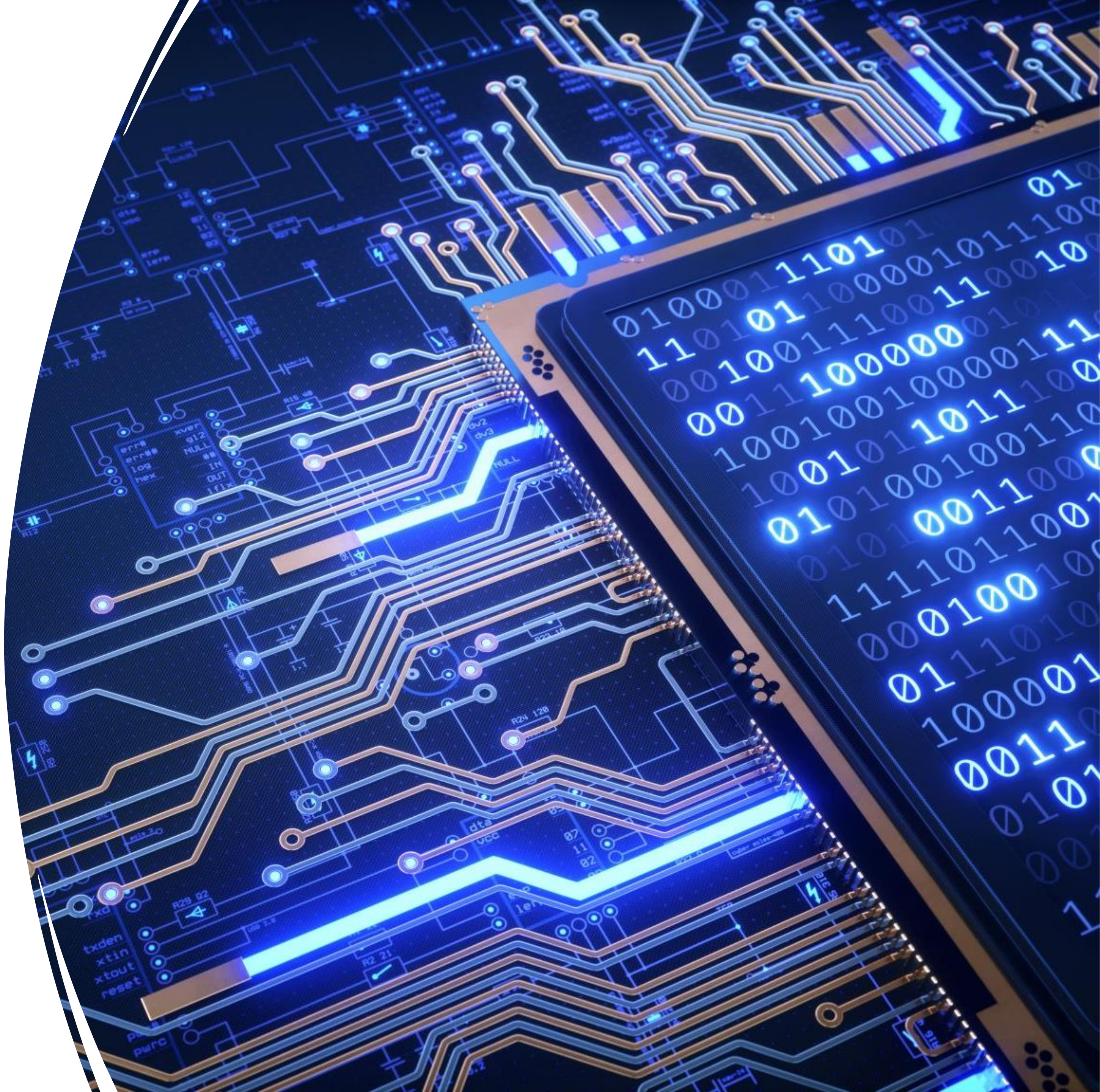


Help people build AI-powered software

Future software will be AI-powered.

How can we build, test, and deploy these systems in a scalable and in a disciplined way?

Important to think about now to avoid “AI debt”.



Provide great human-AI interaction experiences

One of the reason, Copilot was successful because developers already were familiar with the auto-complete experience.

Important to figure out the experience that humans interact with AI system.

Design an experience that makes the interaction seamless.

HCI must be considered from the start

Leverage AI to make research more efficient

Huge potential for AI to be used in research design, data analysis.

Great brainstorming partner.

But keep in mind: AI isn't perfect, so people need to vet suggestions.

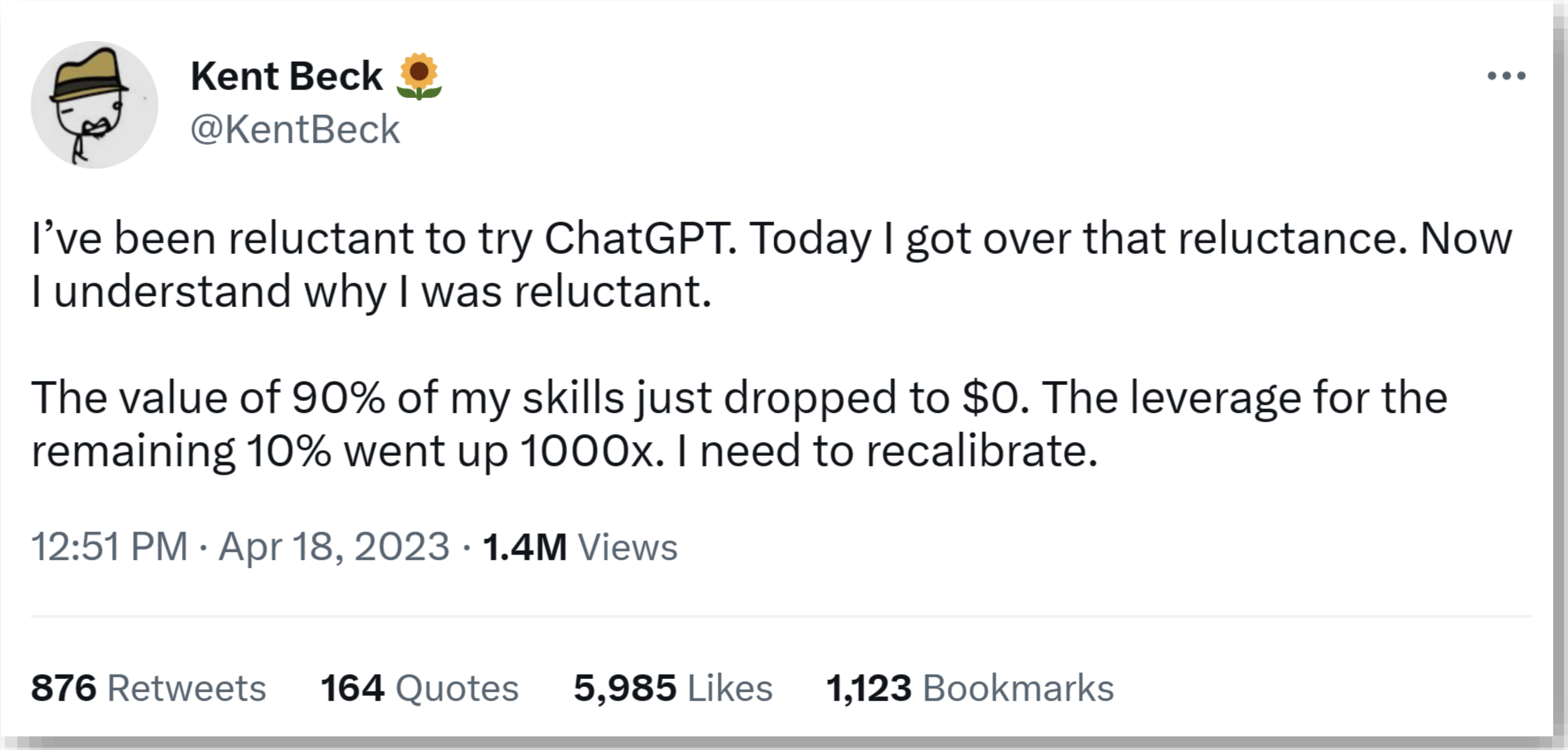
Role of research is changing given the rapid speed of innovation.

Apply AI in a responsible way

How to design and build software systems using AI in a responsible, ethical way that users can trust and do not negatively affect society?

What mechanism and regulations do we put into place to oversee AI systems?

The role of software engineers in the future



Kent Beck 🌻
@KentBeck

I’ve been reluctant to try ChatGPT. Today I got over that reluctance. Now I understand why I was reluctant.

The value of 90% of my skills just dropped to $0. The leverage for the remaining 10% went up 1000x. I need to recalibrate.

12:51 PM · Apr 18, 2023 · **1.4M** Views

876 Retweets **164** Quotes **5,985** Likes **1,123** Bookmarks

https://twitter.com/KentBeck/status/1648413998025707520

Despite these advances, the role of humans in software development will remain essential. Here's why:

1. **Creative Problem Solving**: While AI can automate routine tasks, human developers are needed for their creativity, strategic thinking, and ability to solve complex, unstructured problems. They will focus more on designing solutions, making high-level decisions, and defining the behaviors and capabilities of software systems.
2. **Understanding User Needs**: Humans excel at empathizing with other humans, understanding their needs, and designing intuitive interfaces. This deep understanding of the user is key to developing software that meets their needs and provides a satisfying user experience.
3. **Ethics and Oversight**: As AI becomes more prevalent, the importance of ethical considerations and oversight increases. Human developers will play a critical role in ensuring that AI systems behave fairly, transparently, and responsibly.

So, while the future of software development will be shaped significantly by AI, it will continue to be a human-centric field. Humans and AI will work together in a symbiotic relationship, each contributing their unique strengths to create more robust, efficient, and user-friendly software.

Skills that future software engineers need

(according to GPT-4)

Understanding AI and Machine Learning

Problem Solving and Critical Thinking

Ethics in AI

Soft Skills

Learn to Learn

Domain Knowledge

Systems Thinking.

As a human intelligence, my prediction for the future

The **SE process** will look fundamentally different.

AI agents will be first class members of software development teams.

Human-AI interaction aspects will be important to get right for a successful adoption.

The role of open-source and **open-source models** will grow in importance.

As we transition to AI-powered software, we will need to **avoid or address AI Debt.**

Software engineers will need **additional skills**.

"Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Networking and Information Technology Research and Development Program."

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