

Software Development and Engineering with Large Language Models

Brief Survey of Tools and Perspectives



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Main areas in which LLMs could impact software engineering and development.

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01

Panorama

Software Engineering & Development

Main areas



Requirements Engineering



Design / Planning



Software Development



Testing



Maintenance



Deployment



ML for Software Engineering

Before the advent of LLM-solutions

- Automatic design
- Program synthesis
- Genetic programming
- Issues:
 - they address specific areas
 - they complicate human-computer interactions
 - typically task-oriented (not general purpose)

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LLM for Software Engineering

Why?

- Expose human-level performance in programming tasks. ↗
- General capabilities in "understanding" code.
- Ability to link natural language to code.
- Provide user session to guide code generation.
- Typically used without additional training (zero-shot).
- Potentially can help all of SoftEng areas – see ↗



LLM for Software Engineering

How?



- Fine-tuned models:
 - Code llama [🔗](#)
 - Codex (copilot) [🔗](#)
 - Code-Bert [🔗](#)
 - Zero-shoot learning models:
 - GPT
 - LLaMA
 - Falcon
 - LLM-Engineered approaches:
 - MetaGPT [🔗](#)
 - Reflexion [🔗](#)
 - GPT-engineer [🔗](#)
- . . .

02

Tools



Focus: LLM for Software Development

- Activities:
 - code completion
 - code explanation
 - test generation
- State-of-the art solutions:
 - Copilot (X) [!\[\]\(97d7445697a94970d6443da16b12b5fa_img.jpg\)](#)
 - Amazon Codewhisperer [!\[\]\(258b828d223cb6b35d2b001cf8c6c1e7_img.jpg\)](#)
 - Continue [!\[\]\(3ae3791b31be30fab239cd4ec63dfafe_img.jpg\)](#)





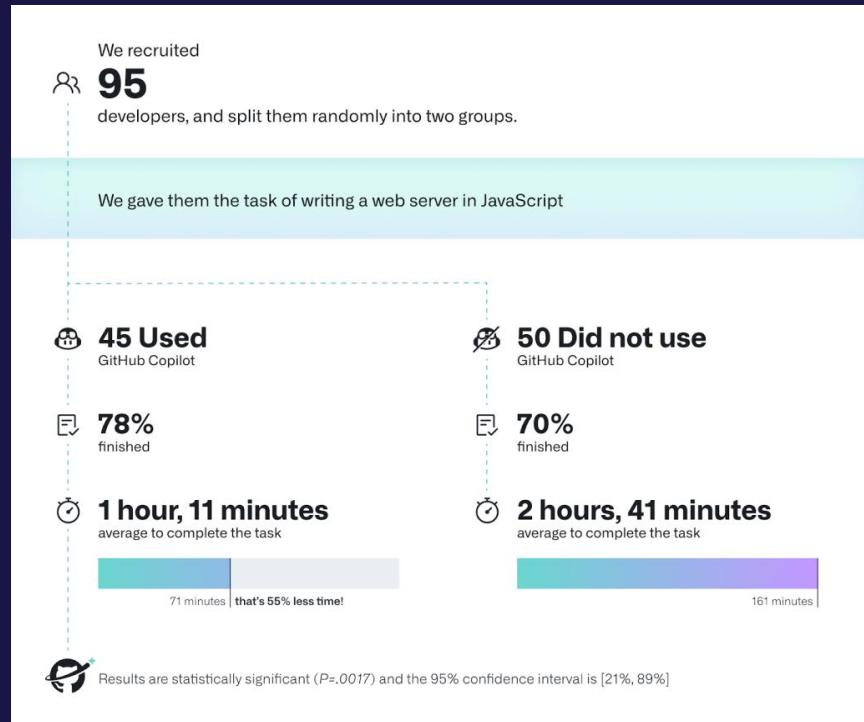
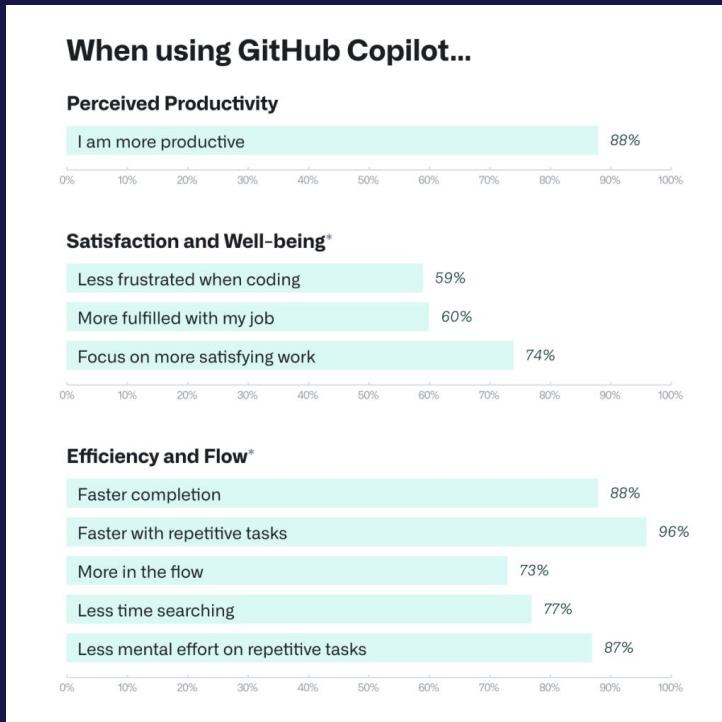
Main Solution: Copilot (x)

- Solution developed by Microsoft specialized for code development
- Released in 2021, now it has more than 1 million users.
- Costs: 10\$ per month (individuals) - free for UniBo
- Integrated in several IDEs
 - VS Code
 - IntelliJ IDEA
- Several concerns:
 - privacy 
 - education 
 - security 
-
-

Demo



Copilot: productivity reports





Other IDE-integrated tools

- **Amazon CodeWhisperer** 
 - Developed by Amazon
 - LLM based solutions trained on thousands lines of code from amazon and open-source projects
- **Continue** 
 - Open source solution
 - ✓ LLAMA
 - ✓ Code LLaMa
 - ✓ Work also with local models
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03

Research



Requirements engineering

- Process of defining, documenting, and maintaining requirements
- Still in early phases 
 - requirements retrieval using GPT-4
 - requirement classification
 - requirements completeness





Software Testing

- Evaluating software for quality by executing planned test cases systematically.
- Main focus: Unit tests generations
- Other interesting topics:
 - test input generation
 - test minimisation
 - debugging
- Key problem: how to ensure that the test is correct? (Oracle problem)
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Other areas

- Maintenance:
 - refactoring
 - debugging
 - program repair
 - performance improvement
- Documentation generation:
- Software analytics





“Full-stack” solution: MetaGPT

- A framework that simulates a development team.
 - It uses several LLMs with specialized prompts to simulate different roles.
 - Starting from a high-level goal, it produces:
 - requirements
 - design
 - cost estimations
 - implementations
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Thanks!

Do you have any questions?

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