

Peer Review

Review of: "Challenges and Paths Towards AI for Software Engineering"

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1. Independent researcher

This manuscript offers a timely, well-structured, and forward-thinking contribution to the rapidly evolving field of AI for Software Engineering (AI4SE). As AI technologies continue to permeate every phase of the software development lifecycle, the paper stands out by offering a holistic and systematic exploration of how AI can transform software engineering practices beyond the now-common applications of code generation and completion. The authors provide a critical synthesis of current capabilities, thoughtfully discuss prevailing limitations, and constructively map out future research avenues—making this manuscript a valuable asset to both academic researchers and industry practitioners.

The manuscript addresses a highly significant and contemporary topic that has seen exponential interest, especially following the success of large language models in automating code-related tasks. Yet, the field lacks comprehensive frameworks that consider software engineering in its full complexity. This paper fills that gap by shifting the conversation from a narrow focus on code synthesis to a broader, systems-level understanding of how AI can be leveraged across the software development lifecycle. The authors' ambition to build a taxonomy of tasks and articulate research bottlenecks demonstrates originality and a deep understanding of the current state of the art.

Moreover, the manuscript's opinionated research agenda is particularly welcome. In a field where progress is rapid but often fragmented, such an agenda provides coherence and direction, encouraging the research community to address foundational issues rather than iterate superficially on existing capabilities.

The paper is logically structured into three main sections, each offering unique contributions that

complement each other. The taxonomy of AI4SE tasks is especially valuable, as it clarifies the multifaceted nature of software engineering and reveals underexplored areas where AI can add value, such as requirements engineering, system testing, bug triaging, architecture evaluation, and technical debt management.

The discussion on bottlenecks is equally well-conceived, identifying concrete challenges—such as limited task-specific datasets, context awareness, evaluation metrics, and tool integration—that must be addressed to move the field forward. Rather than merely listing obstacles, the authors delve into the roots of these challenges, often linking them to broader epistemological and methodological concerns in AI research.

Finally, the research directions are presented with clarity and conviction. The authors successfully balance pragmatism and ambition, outlining pathways that are both technically plausible and intellectually stimulating.

Scholarly Merit and Use of Literature

The manuscript is well-anchored in the existing literature. The authors demonstrate a clear command of both AI and software engineering scholarship, drawing on a diverse range of sources to support their arguments. Importantly, the paper does not simply restate prior work but builds upon it critically and constructively. Where relevant, the authors highlight gaps in current knowledge and use these gaps to motivate their proposed taxonomy and agenda.

The manuscript would further benefit from engagement with recent work in human-centered AI for software engineering, including studies on developer trust, explainability, and collaborative systems. Nevertheless, the core references are solid and up-to-date.

Clarity and Readability

The manuscript is highly readable and conceptually accessible without compromising academic rigor. The writing is articulate, with clear transitions and consistent terminology. The authors do an excellent job of explaining complex ideas without oversimplification. Their use of examples to illustrate abstract points (e.g., what constitutes a bottleneck in real-world settings) is particularly effective. The tone is scholarly but also forward-looking and visionary, which suits the purpose of inspiring future work.

Contribution to the Field

This manuscript makes a substantial contribution to the field of AI4SE by:

- a) Offering a structured and comprehensive taxonomy that will serve as a foundation for organizing future research.
- b) Identifying cross-cutting challenges that limit the applicability and scalability of current AI tools in software engineering contexts.
- c) Proposing an opinionated and forward-looking research agenda that highlights the need for interdisciplinary collaboration, improved evaluation methods, and the development of hybrid human-AI workflows.
- d) In short, this paper is not only a synthesis of the current landscape but also a call to action for the next phase of innovation in software engineering research.

Overall Recommendation: Accept with Minor Revisions

Declarations

Potential competing interests: No potential competing interests to declare.