



Original Article

Beyond Autocomplete: Investigating the Impact of AI Code Generation on Code Quality and Technical Debt

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Abstract - The focus of the study has been on understanding the impact of AI code generation on code quality and technical debt. It has been observed in most cases that the speed of generating codes with the help of artificial intelligence has increased, and it is mostly effective for short works. In larger and complex analyses, there can be a chance of higher redundancy and overhead hosts because of the constant supervision and proper checks that are required. In different areas, the application of AI in generating codes can increase the technical test, the quality of the model, and the architecture is not properly aligned. However, it has also been identified that the proper implementation of AI models and techniques can eventually help in reducing technical debt.

Keywords - Human-AI collaboration, Software quality metrics, Programming automation, Code correctness, Refactoring and AI, Long-term software maintenance, Code smells, Impact of AI on software lifecycle, Software development tools, GPT-based code generation.

1. Introduction

The advancement of technology in the world has provided an opportunity to use artificial intelligence to generate codes for different purposes. It has become important to evaluate whether the generation of code through AI is different from the manual generation of code and whether it impacts the quality of the code, along with the technical debt. Generative AI tools are the reason why the codes are written, and the primary approach is to increase the velocity with which the code can be generated. According to the observations, it has been studied that AI pair programmers can develop goods in less time for a number of tasks. According to certain studies, it has been observed that machine learning or the integration of artificial intelligence can result in compounding technical debt, which tends to be different from the classical debt that was experienced by programmers in different ways.

2. Impact of Ai Code Generation on Productivity and Correctness

According to the results from Controlled experiments, it has been observed that the application of AI for generation contributes to a major increase in productivity levels. A significant study has shown that the application of GitHub Copilot finishes JavaScript HTTP server tasks almost 55.8% faster in comparison to the control setup, where the coding was performed manually by professionals. On the contrary, there are different types, which have a significant impact on the generation of code through artificial intelligence on the correctness of the work¹. A heterogeneous effect has been experienced when the application of AI code generation was considered for large observational datasets. Some of the studies present that the productivity is increased when AI is embedded, but the majority of them have evaluated that there is a negligible net saving due to the entire process of integration overheads and debugging that are included. It has therefore been identified that the improvement in productivity achieved to some extent with the help of AI coordination does not guarantee correctness, and lower maintenance costs because of the overhead areas of control that need to be considered².

3. Impact Ai Code Generation on the Quality of the Codes

There is direct evidence of the impact of AI code generation on the quality of the codes that are generated, and the findings are divergent in nature. GitHub Copilot conducted a study with other controlled experiments, and it was observed that the readability and the pass rates of the code were improved. The primary focus of the study was to analyse the efficiency of the development of code for short tasks and unit test pass rates. However, there have been a number of analyses conducted in the real-time work operations in industries, which have expressed a reduction in the quality matrix when using AI-generated codes. This is because the code that has been generated with the help of artificial intelligence has an increased churn rate and higher chances of experiencing cloning. There is a potential chance of degradation of the security over rounds of automated edits if they are not checked, because of the iterative LLM-guided improvements³. Hence, it is stated that the application of Artificial Intelligence-based models is often subject to the context. The development of codes with the help of artificial intelligence in short tasks can be highly effective and can provide better quality. However, in complex tasks, there will be a constant need to check the way in which the codes are being generated, and proper review practices are required to be implemented to achieve the right results.

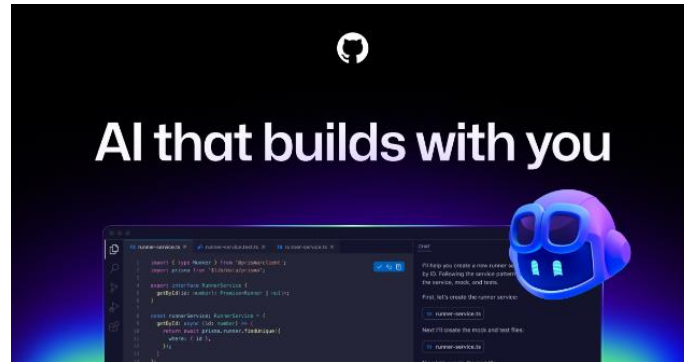


Figure 1. GitHub Copilot

4. Technical Debt in Ai Code Generation

According to the studies, it has been observed that the application of machine learning systems can result in hidden technical debt, such as entanglement, undeclared experiments and boundary erosions, that can impact differently in comparison to the traditional software debt. In the development of the generative artificial intelligence, the concept of prompt debt and the framework glue debt has been observed. These technical debts generally arise when the user-generated code does not include proper quality architecture or security. This eventually results in a higher future maintenance cost and slower development cycles for the users.

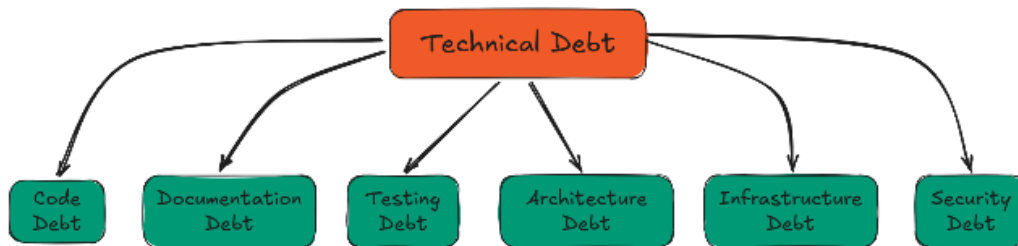


Figure 2: Technical Debt in AI Code Generation

- **Indiscriminate cogeneration:** The rapid and unchecked implementation of AI can lead to the development or the generation of codes that are overly complex and repetitive. These types of codes do not adhere to existing architectural principles which results in the increasing chances of technical debts for the developers.
- **Lack of architectural alignment:** It has also been observed the development of codes with the help of artificial intelligence tools may generate the court snippets that do not fit in the overall design system. This can result a major change in the overall architectural alignment and can create inconsistencies which will increase the future reworks thereby increasing the overall overhead costs.

4.1. Ineffective quality control and the lack of data hygiene

Some of the most significant reasons behind the increasing technical debt in the application of AI generated folds is the lack of quality control. Due to the high speed of AI generated codes developers can often overlook the crucial details such as the security vulnerabilities the complexity of the codes or the proper documentation processes which can eventually contribute to the technical debt. In addition to this it has also been observed that the presence of poor-quality data and ineffective data governance in the application of the AI model can result in technical burdens and hidden costs which eventually increases the technical debts. The studies show properly implementing the concept of generative AI can effectively help in reducing the technical debt of the users by identifying the redundant codes. Since there are a number of subjective areas where the AI generated codes can help in improving the readability of the codes It can therefore help in accelerating the debugging operations and improve the overall technical debts that are included.

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5. Ineffective quality control and the lack of data hygiene:

Some of the most significant reasons behind the increasing technical debt in the application of AI-generated folds are the lack of quality control. Due to the high speed of AI-generated codes, developers can often overlook the crucial details, such as the security vulnerabilities, the complexity of the codes, or the proper documentation processes, which can eventually contribute to the technical debt. In addition to this, it has also been observed that the presence of poor-quality data and ineffective data governance in the application of the AI model can result in technical burdens and hidden costs, which eventually increase the technical debts⁵.

The studies show that properly implementing the concept of generative AI can effectively help in reducing the technical debt of users by identifying redundant code. Since there are a number of subjective areas where the AI-generated codes can help in improving the readability of the codes, it can therefore help in accelerating the debugging operations and improve the overall technical debts that are included.

5.1. Refactoring and code analysis

According to the studies, the proper application of artificial intelligence can contribute to managing the technical debt by analysing the code to understand the areas of complexity, redundancy, and maintainability issues⁶. This provides significant assistance to developers in refactoring the code to address the issues.

5.1.1. Enhanced readability and accelerated debugging

The critical implementation of AI models for the development of code can improve the overall readability of the code and the way in which they are documented. It makes the code base easier to understand and maintain. Simultaneously, the development of the codes with the help of generative AI accelerates the debugging process by providing support to the developers in detecting and fixing the bugs at a faster pace, which eventually reduces the cost of future developments.

5.1.2. Proactive governance

With the help of artificial intelligence, it is possible to achieve better proactive governance in the development workflows. This can help in eventually offering better visibility and ensuring that the accumulation of technical debts related to user AI in developing code can be reduced⁷.

6. Conclusion

It can be concluded from the analysis that AI code generation is becoming highly significant in reducing the time that is required to develop the codes but it does not assure quality the codes are complex in nature. In general, the development of codes with the help of artificial intelligence can result technical debt but if the AI is used in an appropriate way by considering the model and aligning them with the codes it can help in reducing the technical debt.

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