Undergraduate Thesis Prospectus

Response to the Threat They Created: Software Engineers and Automated Software Development

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aidon this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem:

How can computer science programs better prepare their students for careers transformed by cheap, abundant and powerful artificial intelligence?

Top computer science programs in America provide their students with an education that covers everything from programming fundamentals to computer theory while providing exclusive opportunities to work with state-of-the-art technologies (MIT, 2023). While the best educational institutions claim to produce engineers ready for the workplace, artificial-intelligence-based code generating tools like Chat-GPT are able to produce code that rivals the technique of experienced software engineers in seconds (Botpress, 2023). To better prepare students for their augmented careers due to advancements in AI, universities will need to update their curriculum. By teaching students how to produce and consume automated tools and discussing ethical factors that arise when using them, students will be equipped with the tools necessary to succeed in the evolving workforce.

Simulating Real-World Experiences: Teaching Students How to Use Automation

How can an informative automation course better prepare undergraduate students for rapidly evolving careers in STEM?

To fulfill my CS capstone requirement, I will take CS 4991 and an additional 4000 level CS elective. For the technical report, I will research the risks, implications, and initiatives behind using and developing automated tools to propose a class that educates students on the proper use of these technologies.

I had the opportunity to intern at Nationwide IT Services (NIS), a government contracting company, over the summer and learned about automated technologies by creating chatbots for our company website and implementing applications to automate internal processes. By both producing and consuming automated technologies on a daily basis I identified 3 key insights that I will use to base the ideas present in the new course. First, when developing AI/automated technologies, it was important to determine the technology end-users and potential impacts. Without a clear distinction on the interest groups of our application, it's difficult to target what needs this tool would accomplish, reducing the likelihood our clients would use our application. Next, when using AI tools as a supplement to our tasks, it's very important to fully understand the task itself. We used tools such as Microsoft Power Automate and Amazon Lex to assist in our development process. This reiterated that without a fundamental understanding of the overall development kit, AI assistive tools can have a negative impact on the implementation process. The most important thing I learned is that when creating a tool for automating processes, it's very important to analyze what responsibilities will change, how they will affect those involved, and whether the resources invested in developing the tool are worthwhile when considered with the aforementioned conditions. Developing automated tools comes with extremely high risk and reward, and determining these standards might be the most important and difficult part of the development process.

Using the experience I gained from my internship opportunity, I want to create a class that better prepares students for the workplace, but from the viewpoint of automated tools. It's important to realize that these applications will be seen as solutions, not tools, it's the university's responsibility to effectively address this issue.

Responding to the Threat They Created: Software Engineers and Automated Software Development

In the US since 2020, how have entry-level software engineers adapted as AI tools automate software development?

Recently, artificial intelligence (AI) has made great advancements, providing users of this technology an affordable, accessible, and efficient alternative to traditional methodologies. As AI evolves, the domain of its applications inevitably expands, progressing from a simple automation tool to an advanced technology that replicates and even surpasses human capabilities. America's most innovative companies have already started implementing these solutions. At Amazon, for example, 750,000 machines automate the packaging of 1 billion packages, significantly reducing labor costs (Quinlivan, 2023). Chipotle integrated Pepper, an AI chatbot, to resolve customer service requests fully virtually (Ajao, 2022). These technologies aim to automate low-level labor to reduce worker costs. However, as AI continues to evolve higher-skilled occupations that require a college degree are also being replaced. This leads to the question: Can a new computer science graduate outperform an AI chatbot?

Automation has been a core part in the software testing domain over the last decade. Researcher Elfriede Dustin (2009) stated that through automated software testing, testing processes saw an 40-60% increase in efficiency. Instead of testing the software manually, testers could run over one thousand of lines of code using a suite of testing scripts. Recently, Continuous Integration (CI) technologies such as Travis CI and GitLab have been developed which automatically tests code during the development process (Laster, 2017). This breakthrough greatly reduced resources spent on testing and created an industry-wide movement into test-driven development (TDD), an approach where tests are written before any software is

developed. The same pattern can be observed in software development. In the early stages, “automation” was limited to highlighting syntactical errors and auto-filling previously declared variables. This evolved to development environments auto generating common methods and classes based on pre-determined user inputs. All these features provided for software developers were convenient. Around the year 2021, large language models (LLM) and AI-driven code generation tools became widespread. With the capability to generate whole code bases given user requirements, these tools reduced the skillset of an entry-level software engineer to a task that can be automated (Botpress, 2023). When the main responsibility of an entry software engineer can be partially completed by an LLM, further advancements in this technology may compromise the role as a whole.

With the sudden surge of AI-generated code softwares, early-career software developers were given different choices to upskill and stay relevant during this time of change. Even if code can be easily generated, companies will need people who can effectively use AI tools productively (Quinlivan, 2023), and develop these tools (Yokoi, 2023). Yokoi states that middle management groups at large companies will focus more on critical thinking skills and higher-level concepts when evaluating their team members. While technical skills used to be the greatest criterion when determining an entry engineer’s potential, methods to measure employee performance also inevitably evolve as “job roles reshape in ways that involve more high-value activity.” (Doorn, 2022). Big-tech companies such as Amazon, Google, Microsoft, and Salesforce recognized the need for upskilling in their workforce. To help their employees adapt to the evolving needs in their workplace, they’ve invested billions of dollars in educating their people (Newman, 2020). As more technological advancements occur, the minimum skill set needed to succeed inevitably increases.

Workers of all types join unions to ensure they receive equitable pay and deserved rights (CWA, 2023). Surprisingly, there is no official union for software engineers. John Miano, the CEO of Programmer's Guild, which is a union he created for programmers in the early 2000s stated that programmers are "too independent to organize" and need to structure the group "similarly to the Major League Baseball players union" (Miano, 2000). After analyzing several different view-points on unions from forums/communities such as Reddit, Stack Exchange, and Quora, opinions are split between those who state it's better to protect each other given potential unfortunate scenarios, and those who believe that individuals who join a union only cause they're less competent. In short, there is no nationwide union for software developers because of the competitive nature of careers in technology, originating from a great wage difference within the field itself (Miano, 2000). However, the creation of a more structured union is something workers in technology need to develop together. Some workers seek like-minded individuals within their own company to form a community to create a stronger voice. Without a formal method to create change, it is necessary to associate within a group to protect both themselves and those around them (Schiffer, 2021).

Ultimately, AI provides software engineers with additional tools to streamline their workflows and automate menial tasks. However, with vast improvements in technology in the coming decades, AI tools may be used for more advanced tasks in software development process, bringing the potential to replace some programmers. While unions are often formed in other fields, software engineers lack an official union, limiting their ability to advocate against the potential threats and challenges posed by AI technology. As a result, the software engineering job market may decline in the future as some programming jobs are automated, leading to greater competition for recent graduates. Due to these potential impacts, it is essential for recent

graduates to understand the impacts of AI technology in software careers and how they can leverage these tools to enhance and modify the skillsets they are developing to maintain relevancy. For example, by integrating creative thinking and using AI tools, students can develop more complex algorithms and oversee AI systems. Furthermore, increased collaboration and advocacy between students should be emphasized in the classroom to encourage new graduates to advocate for positive workforce change throughout their careers.

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