

## Personal Statement

Md Atiqur Rahman

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In 2020, when the COVID-19 outbreak was at its peak, I along with some of my university peers came up with the idea of a relief activities coordination platform to assist numerous voluntary organizations in providing essential aid nationwide. Despite our dedicated efforts to launch the platform named [Traan-Chitro](#), we encountered minimal interest from these organizations due to their concerns about data security and hesitance to adopt a new system. I was quite disheartened after this setback, but I never stopped thinking why we failed. After some time, it became evident to me that our failure was not due to a lack of project potential, but rather stemmed from the oversight of conducting adequate research before initiating the idea. We overlooked assessing the targeted organizations' needs, their receptiveness to new systems, and their willingness to share data. That was the time when I learnt the critical importance of research, not just in understanding the technical aspects of software engineering and privacy, but also in acknowledging the pivotal role of human factors.

During my time at [BUET](#), I developed a keen interest in software development and security. Engaging in challenging academic projects like creating '[E-luxurious](#)'—a property rental platform like Airbnb—and designing a full-scale [DNS flood attack](#) with a corresponding defense mechanism heightened my skills. I also ventured into multiple outsourced projects to broaden my experience in software development practices. After graduation, I became a software engineer at [IQVIA](#), specializing in C# .NET backend development. In this role, I extensively worked with various DBMS and gained proficiency in writing and analyzing unit tests and BDD tests in Gherkin language. I also focused on improving program analysis techniques to identify and resolve security vulnerabilities in developer-written code, ensuring compliance. These experiences allowed me to closely observe prevailing issues in the software industry, thus motivating me more to pursue a research career in which I can continue to delve further into various facets of software development. My ambition is to excel as a researcher specializing in **Software Engineering, Security, and AI**.

My journey into formal research began with my undergraduate thesis in computational criminology, where I developed a decision-aid system named '[Cri-Astrologer](#)'. Its main purpose was to assist in the conduct of police investigations by predicting criminal demographic profiles using crime evidence data and victim demographics. I proposed, a deep factorization machine based DNN architecture which outperformed existing machine learning and deep learning algorithms in predicting criminal demographics. At IQVIA, I have led research and development efforts to enhance database query performance, reduce query counts, and explore cost-efficient solutions. Currently, I am actively engaged in an R&D project at IQVIA aimed at revolutionizing user interactions with data visualization. The aim of this project is to simplify complex dashboard configurations by integrating large language models (LLMs) into the user interface. This approach will allow users to ask natural language queries and the LLM provides insights to automatically generated charts, delivering an exceptional user experience. Throughout this project, I have explored various LLMs including GPT, Llama and Mistral, delving into prompt engineering and fine tuning these models. Working with LLMs in this project opened a new door of research interest for me: **Leveraging LLMs in solving software and security related problems.**

In pursuing my research interests encompassing **Software Engineering, Security**, and the **Application of LLMs**, I want to combine the strengths of each field to enhance one another. My doctoral research will focus on an in-depth exploration of the software development lifecycle. Specifically, I aim to investigate the versatile applications of LLMs within the software industry. This includes investigating how LLMs can automate tests across various testing frameworks and identifying ways to utilize LLMs in the detection of software stack vulnerabilities. Moreover, I am interested in developing tools to safeguard end-user privacy. My objective is to create practical tools that will significantly benefit the developer community.

I consider Khoury College of Computer Sciences a suitable place to pursue my PhD, as there are several active researchers with whom I believe I will be able to contribute. **Dr. Frank Tip's** research closely aligns with my interests, particularly his work on **Automated Unit Test Generation using LLMs**. Having spent two years in industry, I recognize the significance of unit tests and believe that leveraging LLMs for this purpose can significantly elevate software production quality while easing developers' workflows. Given the chance, I aspire to apply my expertise in working with LLMs to automate unit test generation for the C# .Net framework and explore automation within BDD testing frameworks. I also have a keen interest in **Dr. Tianshi Li's** research in developing tools for privacy requirements. As a developer, I resonate deeply with the growing responsibility of safeguarding user privacy across the software development lifecycle. **Dr. Li's** tools, such as **Coconut**, **Honeysuckle**, and **Matcha**, have significantly influenced the developer community. I am particularly enthusiastic about her pursuit of **democratizing PETs** like differential privacy. If given the opportunity, I aim to contribute by developing supportive tools that assist developers in overcoming technical hurdles related to the adoption of privacy-enhancing technologies. **Dr. Jon Bell's** research on **Flaky Tests** and **Fuzzing** also captures my interest. At my current workplace, the integration of CI/CD occasionally results in randomly failing test cases, impacting the speed and reliability of our pipelines, undermining confidence in our testing procedures. Any findings in this domain would certainly be of benefit to the developer community. As future direction, I am enthusiastic about exploring the performance of LLMs if utilized as a fuzzer. I believe using LLMs to generate fuzzing inputs could potentially resolve several limitations inherent in existing fuzzers. I am also open to collaborating with others who share similar focus and exploring further areas in this domain.

My future goal is to become an accomplished academic, emphasizing both research and teaching while maintaining active connections with the industry. To achieve these goals, I am willing to explore new domains and embrace challenges that arise during my graduate studies.

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