Academic Statement of Purpose
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I'm interested in research that has a focus on using empirical or constructive methods to improve the reliability and efficiency of computer systems. Projects involving quality assurance, testing, and security interest me. However, because I've had limited research opportunities, I'm open to other project topics. My interests in software engineering research developed through many experiences I pursued in search of finding what I enjoyed.

My initial exposure to software engineering came during the first semester of my Sophomore year. I worked as a Software Developer intern for the IT department of a transportation company in Iowa. On top of having to learn a new programming language and navigate a new environment, I collaborated with a company affiliate on developing a web application for international usage. Due to the small nature of the company, I took full control of the development process of the application; from design to testing resulting in its initial public release.

I didn't know much about software or computers before college, so the internship provided me with a more defined technical background. From having to teach myself a new language in a short time period, I learned how to adjust to different programming languages by understanding their purposes, limits, and conditions. I became familiar with the use of different kinds of software tools ranging from web development to testing.

Working directly with the development process improved my conception of efficient software engineering. I vividly remember becoming obsessed with trying to find every loop-hole or error within my program by writing up very detailed test specifications: from incoherent user information to making sure the applications communicated with the Google API appropriately. In my classes, thorough testing was usually done just before I turned in my assignment. However, I came to realize spending time analyzing and organizing the test specifications for my web application was central to efficient development, not just an afterthought. Seeing my work pay off in the end gave me fresh confidence to explore.

With this new found confidence, I wanted to solve more complex problems. During this time I was also captivated by physics, and I ended up pursuing computational physics research. I took part in a research project at Cornell University with Professor Nicole Benedek as my mentor over the Summer of 2019. I studied the relationship between the anomalous behavior of crystals. My time was split between analyzing literature and DFT (Density Functional Theory) simulations. With no foundational understanding of material science, I spent a large amount of time reading from textbooks. Establishing this background knowledge gave me enough insight into what data was relevant to analyzing crystal behavior. I then explored the literature, collected data and simulations on 49 materials, and proposed a theory on how the structure of these materials could predict anomalous behaviors.

From having to teach myself material science, I improved my ability to articulate complex information. I learned how to make sense of empirical data from literature to develop a theory. Although my experience at Cornell aided me with some research skills, it served a more formative purpose. I didn't enjoy the heavy focus on materials science in my project. I left Cornell feeling sure about research but eager to explore something more founded in computer science.

Over the Summer of 2020, I took up a research internship offer at Carnegie Mellon University where I worked remotely due to the COVID pandemic. I worked with Professor Christian Kastner and Professor Clarie Le Goues in exploring patch quality for automatic bug repair. By quantifying some

characteristics that I determined made patches “good”, I constructed a metric that ranked a collection of patches. We used a test-based automatic bug repair tool under one test suite to generate patches for 28 buggy programs. Upon ranking these patches, patches were tested on a second test-suite to evaluate the effectiveness of my rankings. I found that around 80% of the rankings appropriately ranked my more favorable patches higher than my least favorable ones. The method proved to be promising in aiding patch quality of automatic repair tools. My program and metric is now aiding a graduate student in his study.

During this project, I worked with many software systems. I came to see the importance in understanding, at least, some level of abstraction on how each system worked to improve communicating issues. Modern software systems have many distinct parts, each building around each other. The graduate student I was working with supplied me with the patches I needed to do my research as well as the software tools to analyze these patches. Although I was not expected to understand how these various systems came about functioning, like how the automatic repair tool generated the patches, taking the time to understand a level of abstraction of the various processes helped me communicate with the graduate student any errors I encountered. Time that would’ve been lost trying to figure out a problem was saved since I could most efficiently identify the source of the issue. Comprehending these parts also helped me communicate my results and its implications to others outside my project.

Most importantly, the experience solidified my decision to pursue graduate school. Not only did I find my research interesting, at times I found it addicting. When my metric didn’t rank a collection of patches best based on my evaluation of it, I responded by digging deeper into the literature to learn more. I wanted to improve my rankings without needing to be perfect. My job was not to make a ready to ship product for a business, just to show that something was viable. I found myself wanting to break small records or be the first to explore certain paths. I enjoyed taking my own direction. Even after my research internship, I’ve contemplated how I could have improved my results. I’ve pondered if I had instead focused my patch ranking to extract the lower quality patches instead of the better quality ones, would it be a more efficient way of centralizing better quality patches from a collection - a culling instead or ranking. I want to pursue these types of questions, and I’ve concluded that academia will allow me to do that.

A career in academia is my highest goal. Programs such as those in University of Michigan engage in research projects that enlighten my curiosity. I found my interest most closely related to Professors Westley Weimer and Baris Kasiki. Although those particular topics drew me in, my keen interest in the field keeps me open to exploring different projects. I hope to continue approaching the field with the same eagerness I gave the field when I first met it. I believe the Computer Science & Engineering Department and I share that eagerness. Whatever my project becomes in graduate school, I look forward to being part of an academic community where I learn about and help improve other people’s projects, not just on my own.