Personal Statement

When I started my undergraduate career at Indiana University, I had no idea what the field of computer science had to offer. I found my passion within the field of programming languages, both because of the stimulating and intriguing research opportunities and because of the passionate community conducting this research. As a result, I have chosen to pursue a life in academia to encourage other great minds to join this community.

In my introductory computer science class, I met many new people, most notably Jena. Jena was a forty-five year old married mother of two who at the time had a full time job working as an administrative assistant for the English department. I met Jena when we both attended the Grace Hopper Conference for Women in Computing, where we were both inspired by women who had found success in a career where they are a minority. Likewise, we learned about the challenges we faced ahead, and knew one of the ways to combat these challenges was through mutual support of each other and other women like us.

Despite all of Jena's involvements - being a mother, having a full or part time job throughout full or part time school - she found time to support me and other nontraditional students like herself. We both fell in love with the area of programming languages, and often found ourselves being some of few women in the lecture rooms. She graduated in 2017, and I have since had to continue my own, no longer having her constant support and inspiration in the classroom. I recognize that I now play the same role that she did in my life for younger undergraduates.

I believe it is vitally important to support women and other minorities in STEM fields as early as possible. However, this support should be constant, and extended throughout their undergraduate career as well. This first became blatantly apparent when I first worked as an assistant instructor in the introductory computer science course my second semester freshman year. In a meeting, Professor Suzanne Menzel asked all of the assistant instructors how many women were in our labs. I sadly realized that there were only four out of a lab of about twenty-five. She said, "Pull these women aside, tell them how excited you are to have them in your lab section, and most importantly, let them know that you are a source of support for them. **You are now an inspiration for them, as a woman who has succeeded in this class.**"

I understood that my first professor, Sam Tobin-Hochstadt, had also gone out of his way to encourage me to stay in this field. He voiced his confidence in me, even suggesting I could take an upper-level class as a first year student. I concluded that in order for me to make a broader impact and be an inspiration for those pursuing a career in STEM, working as an undergraduate teaching assistant was not enough. The best way for me to do this in the field of programming languages, both in research and in the community as a whole, is through a career in academia. I hope that I can one day inspire both younger students, and non-traditional ones like Jena, to pursue a career in programming languages, whether that be in industry or research. If I can inspire even one student like myself to continue with a meaningful STEM career, the way that both Jena and Professor Tobin-Hochstadt have inspired me, then I will consider one of my most profound life goals accomplished, and hopefully continue to support many more students to come.

Relevant Background

Intellectual Merit. I began my undergraduate career at Indiana University as a computer science major, which was perhaps the most fortunate decision of my life. Within a

few short weeks, I was obsessed. I looked forward to every assignment, which would present a set of new and engaging problems for me to spend hours figuring out, and enjoying every second of it. This fascination came to a head when I took my first programming language theory class. I remember several lectures where I felt emotionally overwhelmed by the pure beauty in the concepts presented before me. I came away every lecture rejuvenated, excited, and hungry for more.

As my hunger and obsession grew, I began taking more classes and attending weekly talks by graduate students. I discovered that not only was there plenty of previous well-defined research I could learn about, but also new and exciting current research that built upon it. I slowly started to understand that a typical software development career wasn't fit for me. An internship at JPMorgan Chase confirmed this suspicion.

As soon as I returned from this internship, I knew I had to start preparing for a career in research. I attended the **Programming Languages Mentoring Workshop at the International Conference for Functional Programming (ICFP)** that fall, which helped me narrow down my research interests to domain-specific language design, compiler design, and type theory. I spent the following spring working on exactly those things: extending a small functional language compiler from a first-order language (functions are not considered values) to a higher-order language (functions are considered values). This compiler, Gibbon, is a project started by Professor Ryan Newton at Indiana University. It transforms programs to operate directly on serialized data, creating highly-optimized programs. This project was mine individually, and I was tasked with finding the fastest methods for performing a translation of higher-order programs to first-order programs. Faster programs mean faster software, which is essential for processing our growing breadth and depth of information.

Further pursuing my research interests, I participated in the Carnegie Mellon University Software Engineering REU program. There, I worked on a case study and design of a blockchain programming language, Obsidian. For the case study, I designed and implemented an application for parametric insurance for farmers in developing countries, an idea that came from economists at the World Bank. Obsidian has many useful features, most notably the concept of assets. Assets denote important resources in applications, such as money, which blockchain applications are often centered around. Assets are carefully tracked throughout the program to ensure that there is no accidental loss of such a resource. My case study resulted in the addition of a new language feature: enabling assets to exist at only certain states of the program. Often, having an entire program be considered an asset is too broad. For example, if a wallet is completely empty, losing it may not be harmful. Conversely, if a wallet is full of money, losing it would be unfortunate. This wallet is like a program; it has two different states: it either contains money, or it is empty. We shouldn't worry about keeping it safe when it is empty, but we should take special care of it when it is full of money. This kind of situation arose while I developed my case study, which is why we chose to add assets at a state level as a feature of Obsidian.

I worked closely with a graduate student, Michael Coblenz, as he invented the language. Together we have a paper in submission to the **International Conference on Software Engineering (ICSE)** in 2019, and I individually have a paper accepted to the **Systems, Programming, Languages and Applications: Software for Humanity (SPLASH)** Student Research Competition. As blockchain applications begin to grow in popularity, significant research should be done into the programming languages that are used for these

applications, to ensure safe and secure software. Many people trust that the applications they use daily will keep their personal information and assets secure. However, this trust has already been broken by current blockchain programming languages; most notably, the DAO exploit was caused by a vulnerability found in a programming language Solidity. Through my research, I can enable programmers to easily create safe and reliable software for their users in a high level programming language.

Broader Impacts. Every semester except for my very first, I have worked as an undergraduate teaching assistant. Being a teaching assistant enables me to mentor students, develop my teaching skills, and share my passion with others. I have often been able to mentor the same students in multiple classes as they progress through their undergraduate career. I noticed, however, the severe lack of resources for students in the introductory course. They had a single textbook, the documentation for the programming language, and an interactive development environment (IDE). I wanted to condense the large textbook down into digestible segments, and I found that making instructional videos was the optimal way to do that. These videos have since been used in the course at Indiana University, as well as in a similar course at Northeastern University, and are free and available online. I have had students from these courses recognize me from my voice, and say that they have found my videos extremely helpful.

What has helped me the most throughout my undergraduate career has been the support system created by my professors and the other students around me. As a teaching assistant, I serve as a part of this support system for students. I take this responsibility seriously, making sure to follow up with students whenever they struggle, to keep up with the material myself, and to ensure that I remember what material I struggled with when I took the course. I would not have been as inspired and successful as I am today without the support I have received from my peers. Finally, as Professor Menzel suggested some years ago, I have continued to reach out to female minorities and let them know that I am especially available for them, as I wish to increase the percentage of females in computer science at Indiana University and beyond.

Future Goals

I have been fortunate enough to find my greatest passions at Indiana University - teaching and research. Achieving an academic career will enable me to continue doing and excelling at both. In particular, **I would like to be a tenure-track professor at a public university in order to serve as an example for other women pursuing higher education**. Many programs exist for girls in high school to encourage them to strive for higher education, particularly in STEM fields. However, once they make the decision to obtain a college degree in STEM, the level of support often decreases. Without continuing support throughout higher education, and with fewer and fewer women in the classrooms, these students may lose their confidence as they encounter tougher subjects. A faculty position will enable me to mix teaching, research, and mentorship. My research has shown me that developing software is difficult, and I wish to make this creative medium more accessible and secure for all. My teaching has revealed that I greatly enjoy sharing my knowledge with students, and mentoring them through their intellectual journeys. I have had the most fulfilling intellectual experiences of my life at Indiana University, and I know that pursuing a graduate degree with the support of the NSF Graduate Fellowship will enable me to have many more.