Academic Statement of Purpose

Watching an old CRT monitor boot up to life as the fans in the chassis revved, left me in awe as a child and often made me wonder how computers truly work from the ground up. While growing up, I would tinker with little electronic toys to understand how they worked. Curiosity further led me from this to building simple LED circuits with Timer ICs, and to eventually building a mini bipedal robot with my first microcontroller in middle school. That was when I recognized my strong affinity toward learning about the science of computing.

Having the desire to explore what engineering sciences had to offer, majoring in Computer Science for my Bachelor's degree was my window to glimpse into the vastness of the field. Throughout my years as an undergraduate, I had the opportunity to collaborate with individuals from diverse engineering backgrounds as well as be a member of multiple research labs such as the Microsoft Innovation Labs and the Center of Pattern Recognition and Machine Learning. Here, I had the chance to explore and contribute to areas such as visualizing mixed reality through haptics and optimizing techniques for facial recognition; these eventually led to publishing a paper and filing a patent. Working in highly collaborative environments at research labs prompted me to participate in team events like twenty-four-hour Hackathons, where my team and I prototyped solutions like building a functional smart-watch, and also a pair of smart-glasses that re-imagine augmented reality through sound during the course of these events. Apart from strengthening confidence in my ability to be able to contribute to engineering solutions, the experience of participating and winning in these events also taught me how innovation across the stack flourishes in teams of people with diverse backgrounds.

Attending a class on introduction to Operating Systems has been an inflection point for me. I was amazed by how a piece of software interfaces and managed hardware resources with efficiency and fairness. My fascination with systems eventually led me to a summer undergraduate internship at Carnegie Mellon University under Professor Saugata Ghose, which I further continued for the rest of the semester for research credits at my home university. Here I helped in profiling memory patterns and designing a memory access simulator to analyze and create memory prefetching algorithms. As I continued my discovery in the world of systems, I learned of the Linux Operating System: its wide adoption from televisions to spacecrafts, its open-source identity, and the community built around it. I came to realize that the Linux kernel project had effectively decentralized innovation, and the true power of collaboration dawned upon me.

With the newfound inclination to dive further into the world of Systems and Architecture, I received an opportunity to intern at IBM India's Linux Technology Center for six months. Here I contributed to the gem5 open-source architecture simulator project to enable the IBM POWER architecture and successfully boot a multi-threaded Linux kernel onto the simulator. Post the internship, I mentored students to continue contributing to this project. I then transitioned into a full-time engineer and primarily contributed to the area surrounding Scheduling and Energy Management for Linux. I had a chance to present a probabilistic approach to choose idle states for energy management that not only helped save energy but also boost performance. I was accepted to propose this feature in the OS-Directed

Power-Management Summit, Italy (OSPM) 2020, and my work in this area was also featured in the Linux Weekly News. Furthermore, I contributed to the Linux kernel and the OpenPOWER initiative for enabling and exploiting architectural-specific energy management features. My contributions with IBM also included the area overlapping CPUs and container primitives wherein I proposed a mechanism to virtualize CPU information on host systems by introducing CPU namespaces. My proposal was published in Phoronix, a leading technology blog, and is accepted to be presented at the Linux Conference Australia (LCA) in January 2022. Additionally, for my efforts, I was awarded the General Manager Awards in the "Exemplary Rookie" category. Undoubtedly, the research opportunities I received have not only driven up my incline toward systems research but also has shaped my perspective on the importance of openness of technology and how meaningful collaborations can leave a positive impact on the world.

The Master of Science in Computer Science program at the University of Illinois Urbana Champaign (UIUC) is a perfectly crafted research-oriented degree that would help me build upon the knowledge gained during my undergraduate study as well as the experiences gained working as an engineer. UIUC is one of the frontier contributors to computer sciences, especially systems research. I am exceedingly fascinated by the projects from Professor Laxmikant V. Kale's Parallel Programming Lab such as the parallel programming paradigm charm++ and its one of many applications in the scope to enable runtime guided per-core frequency regulation. The advances from the ARCANA research group headed by Professor Saugata Ghose toward data-oriented systems modeling and his vision for addressing challenges for processing-in-memory architectures hold great intrigue to me as well. Likewise, Professor Tianyin Xu's efforts in the area of configuration management, correctness on distributed systems using partial histories, and his contributions to secure computing have significantly influenced me. My research interests in the area of High-Performance Computing, Synchronization, Parallelism, and the intersection of Architecture and Operating Systems closely align in the direction that UIUC is pioneering as well. I believe that this program would be a rewarding experience and would greatly benefit me in my path of becoming a Computer Scientist.

I reflect that all my efforts until now have led me down the path in the pursuit of answering the fundamental question that I had as a child when I first saw a desktop computer light up to life - How do computers work from the ground up? I truly believe that we are at the cusp of the next generation of computing wherein the architecture, hardware and operating system are being designed to work in closer conjunction to extract the maximum value from available resources. As computers have become ubiquitous, I reckon it's important now more than ever to lay emphasis on building sustainable computing environments at scale. Collaboration with people from across domains will be crucial in achieving this goal. It would be exciting to orient my research in the areas of Operating Systems, Architecture, and through the intersection of both of them to collaborate in building both performant as well as efficient computing paradigms of the future.