Teaching Statement

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Teaching and advising are crucial activities of academia. Being a professor offers a unique, exciting, and rewarding opportunity to guide and interact with students and help shape their careers. My experiences thus far have made me deeply passionate and excited about teaching and mentorship and the impact they can have. In this statement, I present a brief summary of my past teaching and mentoring experiences and my perspective on teaching and advising, followed by my future teaching interests.

Teaching

Teaching Experience. At CMU, I was a teaching assistant for two graduate level courses. Graduate Computer Architecture (18-740) in the ECE department was a research-based course where I hosted recitations and worked with students on research projects. l led discussions of both seminal papers and the latest research works in the area. I iterated with students to teach them how to critically analyze papers, and identify the fundamental challenges each work is trying to solve as well as the key insights presented. I frequently met with students to help them identify research projects and guided them closely throughout the course. One of the students, Ashish Shrestha, continued to work with me after course completion and this led to work published in MICRO 2016. I also served as TA for graduate-level Optimizing Compilers (15-745) in the CS department. For this course, I delivered lectures, hosted recitations, managed LLVM labs, helped create exams, and guided class projects. In the guest lectures, I tried to connect concepts with real-world use cases and tried to engage students by asking leading questions which allow them to arrive at solutions themselves. Two students from this course continued to work with me after the course on a project that was published in ISCA 2018. In both courses (with 20+ students), I was the sole TA. The small classes enabled me to work closely with students and I took it upon myself to ensure that every student had the support and motivation he/she needed. I owned every aspect of the course to ensure its success. During my undergraduate studies at PES Institute of Technology, Bangalore, I assisted in three undergraduate courses (with 100+ students) on Power Systems, Digital Signal Processing, and Linear Integrated Circuits, where I helped create homeworks, supported labs, and graded exams. These experiences gave me a first look into what it takes to engage students effectively and teach large and very diverse student bodies.

Teaching Philosophy. First, I strongly believe in a *hands-on approach* to learning new areas. This involves having students build systems, applications, frameworks, etc. that enable understanding firsthand what the different tradeoffs and challenges are and the design choices in building any system. In my experience, well designed class projects had students thinking and looking into aspects well beyond the course curriculum in their attempts to build the fastest or most efficient designs. Another approach is to have students apply course material to their own research via semester-long projects. I found that this significantly increased their motivation, resulting in fascinating and very promising cross-disciplinary projects.

Second, I believe in open-ended projects and exam questions that require *creative* solutions and encourage *out-of-the-box* thinking. Having project components that have *no specific solution* is a great way to engage students, teach students how to put their unique ways of thinking to effective use, and prepare them to always think beyond existing approaches to solve problems (a critical aspect of research).

Finally, I strongly believe in encouraging students to continuously ask questions, teaching them how to find the right question to ask about any system design or principle, and leading them to arrive at solutions themselves via interactive discussion, rather than purely lecture material.

Mentorship

Mentorship Experience. During the course of my PhD, I closely mentored many students (14 overall) including junior PhDs, Masters students, and research interns at CMU, ETH Zurich, and the University of Toronto. Please refer to my CV for a full list, along with the research outcomes. Each mentoring experience was different: in some cases, they closely worked with me on research projects I led and in others, I helped shape their own research directions (usually senior interns and junior PhD students). For example, several of them—Abhilasha Jain, Diptesh Majumdar, Abhishek Bhowmick, and Ashish Shrestha—played instrumental roles in two of the bigger cross-layer research projects that I led. I helped them select parts of the project suited to their interests and worked closely with them to come up with ideas to address each research challenge, find practical solutions, and build full implementations. These projects led to publications in ISCA 2015, MICRO 2016, and ISCA 2018. One of the Masters students I closely mentored for a year, Abhilasha Jain, is now a PhD student in the CS department at CMU and is continuing to pursue new directions along the similar lines of research.

As a visiting student at ETH Zurich, I was the senior-most student in my advisor's new research group in ETH. I actively mentored junior PhD students on all aspects of research, including identifying research directions, selecting problems to solve, generating ideas, and writing/presentation. I lead collaborative research projects, drove brainstorming sessions to identify new directions, and personally worked with students to ensure they are on track.

These experiences, while difficult and challenging at times, were rewarding and valuable opportunities to work with students of different seniority levels and backgrounds. I find such student-mentor relationships mutually enriching, enabling both parties to learn and grow: For example, I worked closely with Hasan Hassan, who is now a PhD student at ETH Zurich, when he was a research intern at CMU; during this time, we worked on projects published at HPCA 2016 and HPCA 2017. While I helped him learn how to write, present, formulate, and articulate his research ideas, I learned much about DRAM testing infrastructures from him.

Mentorship Philosophy. The overall goal of mentorship is to enable students to grow into mature and independent researchers. Based on my experience, both in receiving and providing mentorship, I describe several important things I learned that drive my mentorship approach.

First, it is crucial for any student to be motivated and driven to solve the research problem he/she is working on. Clear ownership of research projects plays an important role in this. Careful selection of research projects with a clear vision of broader impact is another critical aspect. For junior students, this also involves quickly gaining momentum and confidence by starting with well-scoped and clearly defined problems. I believe in building close working relationships with students to motivate them to believe in themselves when the going is tough, and persist to solve challenging problems.

Second, *thinking clearly* is one of the most important skills for doing great research. To this end, I will strongly enforce *writing* and *clearly presenting/articulating* problems, ideas, and solutions from the beginning. Thinking clearly and writing clearly are highly correlated. Thinking clearly is crucial in identifying fundamental problems to solve, breaking down complex notions into simple digestible parts, and cutting through the technical noise to discern the key insight that drives a solution. Clear thinking also enables a critical aspect of research: to clearly and concisely disseminate ideas so that they can have impact.

Finally, I strongly believe in fostering a rich collaborative spirit within the research group. I believe that student peers are as important as advisors in enhancing research skills, generating new big ideas, and providing different research perspectives and sounding boards. A positive and collaborative research group is also imperative to building social and emotional support to navigate the ups and downs that come with every PhD experience. *Outside* collaborations with other faculty, students, and industry, are also critical to doing interdisciplinary, cross-cutting research driven by real-world problems.

Teaching Interests

My experience in computer systems thus far has prepared me to teach undergraduate courses in computer systems, digital design, operating systems, parallel programming, compilers, computer organization, and computer architecture. At the graduate level, I can offer courses in parallel programming, parallel architectures, memory systems, compilers, and computer architecture. In addition, I am excited about designing a cross-layer systems course that takes a hands-on approach to understanding abstractions between key layers of the stack—the programming language, compiler, and hardware—and the fundamental consequences and tradeoffs in terms of generality, performance, and productivity. This course would have students develop a full-system application-specific (or technology-driven) accelerator from the ground up, including defining the instruction set, building a hardware implementation on an FPGA using high-level tools, developing a compiler backend, and creating a simple productivity-enhancing domain-specific language (DSL) to program it.