Minxuan Zhou — Teaching Statement

My dedication to teaching has evolved through my experiences as a teaching assistant for the graduate-level course on *CSE237A - Introduction to Embedded Systems* in the Department of Computer Science and Engineering at UCSD in Winter 2020. This course was designed to teach students the principles of embedded systems with an emphasis on **hands-on experience** of building real embedded systems. In the *CSE237A* course, my responsibilities included designing individual projects, mentoring students on independent team projects, designing homework and exams, holding office hours, and teaching two lectures as a guest instructor. I also contributed to the inclusive teaching environment in this class, which had 30-40 students from the Department of Computer Science and Engineering and the Department of Electrical and Computer Engineering with diverse backgrounds. In addition to the in-class teaching, I have extensive experience in mentoring students' research. Throughout my Ph.D. study at UCSD, I have mentored 9 Ph.D., 5 master's, and 11 undergraduate students, 13 of whom have published or submitted papers with me. I have mentored 5 undergraduate students from backgrounds historically underrepresented in STEM, one recently started the Ph.D. program at UCSD after 2 years of research under my supervision. Given my past academic experiences, I am qualified to teach courses on **computer architecture** and **embedded systems** at both undergraduate and graduate levels. In addition, I am capable of teaching courses related to computer systems and programming, such as **operating systems**, **system programming**, **compilers**, **computer networks**, **algorithms**, and **data structures** at the undergraduate level.

Teaching Philosophy

I focus on triggering students' **intellectual curiosity** [3] and teaching them **logic behind the problem-solving** [5]. I want to ensure students not only absorb but also **actively learn** the knowledge to solve real-world problems [2], where I emphasize **hands-on experience** when designing courses [1]. Furthermore, I believe an **inclusive classroom** is essential to the success of all students with diverse backgrounds [4].

Curiosity motivates active learning

Students' curiosity is a powerful catalyst for active learning that helps students engage in learning dynamically, instead of passively reception. To teach a course, I prepare materials that spark interest and curiosity, such as the historical motivation behind this class, intriguing questions, emerging real-world challenges, and thought-provoking scenarios. I encourage in-class interactions that motivate active learning. I will also try other ways to stimulate students' curiosity, such as mentoring projects on emerging applications or inviting guest speakers from industry. In the *CSE237A* course, I mentored groups of students to design and implement independent embedded system projects. I prepared the emerging applications that may trigger the most interest among students, such as a driving assistant system in a real car, a tide monitor in the sea, drone-based fire detection systems, etc. I also encouraged them to come up with systems they are interested in. Through these strategies, I found students took an active role in their learning process and promoted a deep and lasting engagement. Several students chose to conduct research with me after the course. One student, Muzhou Li, collaborated with me on 2 publications as a primary contributor [8, 6].

Teaching a method is better than teaching an answer

While providing correct solutions, guiding students through the thought processes and methodologies that lead to those answers is crucial. This approach encourages a deeper understanding of the knowledge, as students grasp the logic behind each step. It promotes critical thinking and problem-solving skills, enabling students to approach challenges with confidence and adaptability. **Hands-on projects with well-designed guidance** are essential to teaching students the key problem-solving methods. In the *CSE237A* course, I designed an individual project that requires students to build an embedded system with real-time scheduling of various sensors using an instrumented Linux kernel on Raspberry Pi. To help students gradually implement complex systems, I set several milestones and provided intuitive tutorials with checkpoint questions. Furthermore, I assigned a competition for implementing the most energy-efficiency scheduling algorithm, that motivates students to understand real-time scheduling fully. To help students focus on the algorithm design, I implemented a scheduling framework in which students only needed to implement their algorithms in one function.

Creating an inclusive learning environment is essential

An inclusive learning environment where all students feel valued, supported, and able to thrive is crucial for their academic success. As an educator, it is vital to implement teaching practices that are sensitive to the needs of all learners. For example, the *CSE237A* course attracted students with diverse technical backgrounds due to the significance of both software and hardware in the course content. To help all students follow the course pace and effectively learn, I designed the homework and experiments emphasizing the interaction between software and hardware. I carefully prepared the materials, including homework solutions and experiment tutorials, to help students who lack experience in one area easily absorb. Furthermore, I encouraged the collaboration between students with different skill sets in independent team projects. I kept providing the necessary guidance on deciding the topic and progressing the project to ensure all students made significant contributions.

Teaching Interests

Given my research and teaching background, as a professor, I am prepared to teach graduate and undergraduate courses on **computer architecture** and **embedded systems**. I am also capable of teaching other related courses in the area of systems and architecture, such as **computer organization**, **system programming**, **digital system design**, etc. Furthermore, I am comfortable with teaching undergraduate-level courses on **operating systems** and **compilers** due to my previous research on micro-kernel operating systems and intern experiences with the system/compiler teams in several companies, including Alibaba, Meta, Apple, and Intel. I am also capable of teaching courses related to **programming**, **algorithms**, and **data structures** at the undergraduate level, due to my experience in programming contexts, including Olympics in Informatics and International Collegiate Programming Contest, since high school. Furthermore, I am excited about developing a graduate-level course on emerging hardware technology and software-hardware co-design for next-generation computer systems. This course will consist of lectures on emerging technologies, discussions on recent research efforts, and **hands-on** projects that allow students to analyze emerging applications on various hardware platforms, by using real systems or simulators. I aim to teach students the critical role of hardware technologies in today's computing.

Mentoring and Outreach

I am passionate about mentoring junior students in research. I have been fortunate to work with more than 25 talented students at different program levels as a research mentor. 13 of them, including 3 undergraduate and 3 master students, have published papers in top-tired conferences and journals, for which I was either the lead or one of the primary supervisors. I am also committed to promoting DEI in my mentoring. Specifically, I am a mentor in the UCSD Computer Science and Engineering Early Research Scholars Program (CSE-ERSP), which aims to promote students from backgrounds historically underrepresented in STEM. I have mentored 5 CSE-ERSP students. One ERSP student, Xuan Wang, continued conducting research under my supervision after the CSE-ERSP program. We have collaborated on two papers, where we are co-first authors, including one published at the 2023 Design, Automation and Test in Europe Conference (DATE), a premium conference in electronic design automation [7]. The research project is an automatic framework that optimizes the execution of machine learning workloads on emerging hardware, which is significantly challenging to a sophomore. To help her proceed with the research, I designed several **hands-on** assignments on various topics for her after the initial learning of basics. For example, she began implementing a simple PyTorch-based tool to generate the machine learning model information in a specific format used by our framework. Then, I guided her to extend the project with more functionalities gradually. Under my supervision, she has significantly grown as a researcher with solid capability in machine learning algorithms, compiler-level optimizations, and emerging hardware technologies. She recently started the Ph.D. program at UCSD and continues working with me on emerging computer architecture and privacy-preserving ML algorithms based on post-quantum cryptography. In addition to mentoring students in college, I am currently participating in mentoring students from High Tech High Chula Vista, a high school in the underserved community of South Bay San Diego.

References

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