Teaching Statement

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Teaching and advising are two of the most important activities of academia. I am enthusiastic about being a faculty member because it holds out the promise of engaging students in these activities, which is also essential to my academic career.

1 Teaching Experience

I have served as a Teaching Assistant (TA) for a graduate-level course, ECE 382M VLSI Physical Design Automation, at the University of Texas at Austin. This course covers advanced VLSI physical design automation topics and features a mid-term exam, bi-weekly problem sets, coding assignments, and a final research-oriented project. I updated course slides with new content, designed new questions for the mid-term exam, graded all assignments/exams, and held TA office hours to help students review class contents and answer questions regarding past assignments.

I helped develop the course by creating a new teaching mode, coding exercises, for this course, which requires students to design data structures and implement core electronics design automation (EDA) kernels with resource and runtime constraints, e.g., partitioning for floorplan and pathfinding for routing. I developed the open-source codebase from scratch that is tailored to the average coding capability of students and designed automatic testing and grading system. I held tutorial sessions to give a general introduction to the benchmark, codebase, and detailed requirements. This provides students with a great opportunity, complimentary to the in-class high-level introduction, for a deep understanding of the physical design algorithms and, most importantly, hands-on programming exercises.

For the research-oriented final project, many students find it challenging to develop novel ideas or implement new algorithms because they had limited research and coding experience at the beginning of the class, which I believe are critical skill sets for both academic and industry careers. I scheduled 1:1 meetings with each group to recommend reading resources of the literature of their selected topic and coding examples. I also guided brainstorming and encouraged students to express their thoughts, construct innovative ideas, and finally generate practical plans with a concrete goal and a clear division of responsibilities according to their capabilities. I also helped organize the final project presentation and gave feedback to the students.

While at the end of the semester, they gained EDA knowledge, practiced coding skills, and produced decent results in the final projects. I received an average student rating of 4.9/5 and enjoyed mentoring and interacting with students.

2 Teaching Philosophy and Approach

My teaching philosophy holds three cores.

First, lectures work best when they show strong intuition and motivation. Strong intuition and motivation mean the lecture itself tells a consistent story from the origin of the field and conveys a close connection with practical applications in broader disciplines. A good motivation for a certain topic, especially for highly-abstract theory/principles, can largely raise the students' curiosity, let them know why they should spend time learning this, and help them understand the content from multiple angles given the diverse background of students. Literature surveys, group conversations, and open-ended discussions are great approaches suitable for both undergraduate-level and graduate-level students.

Second, I believe the integration of theory and practice makes good teaching, especially for topics at the cross-section of hardware and software. It is critical to help students build the capability of problem formulation. The lectures can never cover all prior solutions to all problems, especially in the rapidly-advancing fields, e.g., efficient AI and emerging AI hardware. Instead, I plan to give students a systematic frame that pinpoints key areas and challenges and help them lay solid foundations by teaching foundational principles and classical approaches with milestone progress. Besides theoretical formulation, it will be more effective to learn through exercises to gain hands-on experience by solving real-world problems. Through programming, physical implementation, experiments, and comprehensive study, students can thoroughly understand the principles, working mechanisms, and their practical value. Above all, the key is to teach and inspire students to find critical problems and innovative solutions.

Effective approaches include laying a solid foundation by teaching students principles with detailed examples and encouraging collective creativity with paper reading, sharing, and group class projects. For lower-level undergraduate classes, labs and exercises are great modes to link theoretical knowledge to practical applications. For graduate-level classes, research-oriented projects, labs, programming assignments, and in-class contest can stimulate their potential and creativity that benefit their future career.

Third, I believe in teaching students in accordance with their aptitude and background. Due to individual interest diversity and education resource imbalance in different countries and regions around the globe, students' interest, expertise, and career plans can vary significantly. It is important to construct a teaching methodology that is customized to students' backgrounds to accommodate the pace of different learners. For example, I will make the course self-contained to allow beginners to quickly ramp up with pre-requisite basic knowledge. I will also provide optional problem sets, reading resources, and bonus questions in exams for both advanced and less-experienced students. Another effective approach is to assign students with complementary aptitude to the same group for homework and projects and encourage them to have more communication and learn from each other.

3 Teaching Interests and Plans

My research, teaching, and work experience cover circuits, architecture, and algorithms. I am qualified to and would readily commit the effort to teach both undergraduate-level and graduate-level courses, including digital logic design, machine learning, data structure and algorithms, VLSI, parallel computing, computer architecture, emerging AI hardware, domain-specific accelerator, VLSI CAD/physical design, and applied AI/ML for co-design. I will develop courses to convert advanced cutting-edge topics that my research focuses on, e.g., emerging computing hardware, photonic computing, cross-layer co-design, efficient AI/ML, to introductory lectures for students at all levels to learn foundational knowledge together with real-world use cases.

4 Advising and Mentoring

I am excited to advise undergraduate and graduate students and help them grow into innovative, thoughtful, and productive researchers. I have helped mentor one completed Master thesis and mentored 3 graduates on their research. These mentoring and learning experiences are mutual. I enjoyed helping students develop their research skills and taste. I also found it rewarding when I learned new things from them and deepened my understanding in a more systematic and organized way through conversation and discussion. For example, I have helped Yunfei Sun, an ECE Master student, to develop his Master thesis, "Design and optimization of multi-operand ring resonator based efficient optical recurrent neural network." He extended one of our photonic computing engine designs through this thesis into an optical recurrent neural network. He learned how to utilize integrated photonic devices to construct electronic-photonic computing engines, extend my open-source codebase for model training, and perform optical simulation for functional validation. The following quote is from the Acknowledgments section of Yunfei's Master thesis: "I would also like to appreciate Jiaqi Gu... for their help and useful suggestions when I face difficulties in the research. I benefit a lot from the discussions..."

I currently mentor a junior Ph.D. student Hanqing Zhu in our group on his research. I have worked with him individually with weekly brainstorming to guide him into the emerging AI hardware field, help him pick topics aligned with his interests, create research blueprints for his dissertation, and provide professional training on programming, paper writing, and presentation skills. He worked closely with me on photonic AI computing and hardware-software co-design. I am proud to see his rapid growth, great productivity, independent investigation ability after his first two years, and, most importantly, continuous momentum. I also mentored a female junior graduate student Zhili Xiong and a junior Ph.D. student Souradip Poddar to help them start off the research journey. Through 1:1 meetings, I encouraged them to explore foundational and practical topics in the field of VLSI design automation and shared my vision and advice with them. I was pleased to see they all found their focused areas in advanced VLSI placement for FPGA/ASIC and quickly ramped up to investigate and innovate.

The path to great research goes alongside great students. As a professor, I will recruit students excited about our research directions, share with them my knowledge, skills, and vision, focus my energy on their professional growth, and work with them to advance our shared research agenda.