

Teaching Statement

Bill Tao

Education is of utmost significance both for science and for the whole of humankind. The unique opportunities to educate and mentor the next generation of future computer scientists and engineers are also what attract me most towards academia: in the industry, I might have chances to solve challenging problems that generate huge impact, but I will not have a chance to teach a class of undergraduate students the essential knowledge of computer networks and enable them to build and debug complicated real-world computer network systems individually, nor will I have a chance to mentor PhD students for several years and influence how they approach the problems in research.

1 Teaching courses

Teaching experience During my Ph.D. journey at UIUC, I had the privilege of being the teaching assistant (TA) for 2 courses: CS 438 (Computer Networking), with Dr. Deepak Vasisht, where I graded several homework assignments and machine problems (MP) and held office hours to help students debug their MP code. I have also been a TA for CS 538 (Advanced Computer Networking), with Dr. Philip Godfrey. I had the opportunity to give a lecture during my TA experience in CS 538, and I have also given a guest lecture at the University of Pittsburgh's CS 2520 course (wide area networks), and both lectures focused on satellite networking.

Teaching philosophy My premier teaching philosophy is that there is no one-size-fits-all syllabus for a course; the content should always be tailored to the audience. The differences in the design of these two courses reflect well this idea of "fit the need of the students".

CS 438 is an undergraduate-level course, and the students were relatively junior. The course mainly contains basic knowledge of the network protocol stack, with a lot of hands-on machine problems (MP), where students were building and debugging network systems. In contrast, CS 538 is a graduate-level course where the students were mostly looking for ideas to generate research projects. The course mainly contains reading and discussing research papers from recent top conferences, and a research project and presentation. From the final course evaluation forms, I could see that the students in both classes found the class helpful for themselves.

During my lectures, I mainly focused on interesting research topics and open-ended questions in satellite networking. This strategy proved to work well as multiple student groups found satellite-based research projects for the course, and I have received inquiries from students regarding future research collaboration opportunities.

Besides fitting courses to the audience, I do believe that there are necessary skills we have to teach our students, and above all technical details are the collaboration skills. Whether students want to pursue an academic or an industry career, they need to collaborate with others. This means that e.g., the students need to use *others'* code and write code for *others* to use. This requires good communication and negotiation skills, as well as adhering to a common protocol. These skills are not naturally taught with the basic knowledge on programming, but can be practiced by collaborative activities in class such as class projects.

Teaching interests I am excited to teach computer networking and wireless systems at all levels. At graduate level, I will design a course that briefly reviews the network protocol stack and some classical and influential literatures such as congestion control, and then moves on to the newest research topics in networking. At undergraduate level, I plan to teach the details from top to the bottom of the network stack, enabling students to build a networking system end-to-end. Besides, I am also qualified to teach other system and networking-related courses such as distributed systems, IoT, cyber-physical systems and embedded systems, as well as basic introductory courses like data structure and algorithms, signal processing, etc.

2 Mentoring students on research

One key benefit being a faculty for me is the opportunity to advise PhD students and help them grow to be independent researchers. I have personally found my PhD journey to be joyful overall, and I aspire to help

my students enjoy their PhD as much as I do.

Mentoring experience Throughout my PhD journey, I had the privilege of working with several undergraduate students, master's students, and junior PhD students. Seeing our collaboration produce positive results and publications has been a highly rewarding experience for me.

During 2022 and 2023, I worked with an undergraduate student, Om Chabra, on Serval (NSDI 2024), a smart edge computing framework for low Earth orbit satellites. Om demonstrated a strong understanding of the Python programming language but was not very familiar with writing code for large projects or systematically evaluating a system design for a research paper. To address this, I set up a code review process for our group and took the lead in designing experiments for our system, while entrusting Om with the task of writing the initial code for our satellite simulator. Through our collaboration, Om gained significant experience in coding for a large research project as well as designing and running experiments. He is now pursuing his PhD at MIT EECS.

In spring 2024, my labmate Jay Shenoy and I worked with two undergraduate students, Davis Zhang and Shlok Mehotra, on S4 (Remote Sensing '24), a transfer learning framework for satellite imagery classification. Both Davis and Shlok were familiar with the PyTorch deep learning framework, and Davis was especially proficient in implementing the methods in our paper as well as baselines. However, they lacked experience in running large-scale ML training tasks in parallel. To help them, I provided hands-on guidance on parallelizing our training tasks on the SLURM-managed campus cluster. In the end, we successfully completed all experiments on time, and Davis and Shlok are now confident in using clusters to train ML models.

Starting fall 2024, I have been working with another junior PhD student in our research lab, Seoyul Oh, on a research project about decentralized cellular service provided by LEO satellites. This project involves a great amount of work with low-level radio and networking code in C/C++. While Seoyul lacks this type of experience as a junior PhD student, I believe that such skills are very important to conduct further researches in her direction. Therefore, instead of taking the low-level coding tasks on my own, I provided guidance to Seoyul and let her do the experiments herself. In less than one month, Seoyul has already become more proficient in handling large C projects and debugging radio and networking hardware.

Mentoring philosophy Similar to my teaching philosophy, I believe that the essence of mentoring students is to recognize that each student is unique with their own strengths and weaknesses, and it is the mentor's responsibility to help the student gain necessary skills for their own success. However, in spite of the diversity and uniqueness of each student's situation, I do believe that there are common principles that I would like to implement in my mentoring.

First, I believe that one common necessity is to support students and encourage them to be confident in their merit. From my own experience of PhD, I understand how easy it is to lose confidence in oneself as a PhD student, especially after letdowns such as paper rejections. Oftentimes, even if the students' work is solid and novel, it might be rejected due to the inherent randomness of the reviewing process. As an advisor, it is important in these situations to recognize the achievements of the students and help them address the area of improvement so that they will have better results in the future.

Second, I believe that the skills of presentation and communication is of utmost importance in a PhD program. The students come from high school and undergraduate courses, where most questions have standard answers and they need only to calculate that answer right. In research, however, a highly valuable result can be misjudged if not presented well, and this applies to both paper writing and giving talks at conferences. Personally, my advisor Dr. Deepak Vasisht has always emphasized giving clear and concise talks at conferences, which helps our research group better engage audiences and provoke deeper discussions. To help students become effective communicators, I will prioritize clear feedback on writing and encourage practice through mock presentations and collaborative discussions.

3 Outreaching to other communities

I believe computer science education is not just in my university and under my official capacity. For example, we need to promote the awareness of CS among K-12 students, to show them the opportunities and what they can expect in a CS career, so that some of them might find their interest in this field at an early stage and that we can plant the seeds for future computer scientists. Personally, I had the opportunity to interact

with K-12 students on multiple occasions. Teaching second-grade elementary students programming with visual and interactive tools, such as a cartoon game, showed me how early engagement fosters curiosity and interest in computer science. I have also talked to high school students during the UIUC engineering open house event who were considering studying CS at UIUC and were interested in learning the curriculum and future career options of a CS degree. I have also joined the Networking channel, where several other panelists and me discussed how to choose a research topic for one's PhD, and shared our own experiences and lessons learned during our PhD journey.