Teaching Statement **Hang Qiu** **hangqiu@stanford.edu**

Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime. – Lao-Tzu

I value the opportunity to teach and mentor students as I am passionate about passing on my knowledge to next-generation scientists and engineers, establishing fundamentals to cultivate expertise, invoking curiosity and independent critical thinking to break limits, and inspiring ideas for future innovation. I have had the privilege to serve in various teaching and mentoring roles, as well as being a close observer of exceptional world-class instructors. This experience has informed my approach in systematically presenting knowledge, making it more accessible to students, curating comprehensive syllabus, and shepherding students towards successful careers. As a faculty member, I look forward to becoming an inspirational scholar who prepares future generations with expertise, enthusiasm, and integrity to innovate for the social good.

Teaching Experience

My teaching philosophy is to cultivate independent critical thinking that breaks traditional boundaries, tackles real-world problems, and sparks novel innovations. My methodology is to assemble knowledge in a systematic way, to invoke ideas via interactive discussions, and to engage students with hands-on experience, connecting concepts with concrete examples through assignments and implementation.

As a co-instructor for *EE292D/CS329E: Machine Learning on Embedded Systems* (Fall'21) at Stanford, I helped students design various ML applications on embedded devices, ranging from correct mask-wearing detection, to lane detection for autonomous driving, solar power estimation based on cloud observation, and super-resolution GANs, *etc.* In these projects, students need to use what they learned from the lectures to deploy ML models on embedded devices (Coral Edge TPU boards and Arduino boards). It is very challenging to squeeze the models into these tiny devices. To help the struggle, I released my research ML-EXray as a debugging tool to help students validate their deployment, examine latency bottlenecks, and evaluate performance. ML-EXray adds an interesting component to the projects, inspiring students to dig deeper, rethinking model architecture design accounting for kernels and ops. Through interacting with the students, I also get the first batch of users and feedbacks towards open-sourcing ML-EXray to the public.

As a teaching assistant for *CSCI 551: Computer Communications* (Fall'17) at USC, I led the redesign of the entire course's lab assignments, engaging students to build from lower-layer protocols (ARP, OSPF) on individual switches and routers, all the way up to a mini-internet (BGP, TCP, BBR). Throughout the process, I gave introductory lectures linking back to the body of literature students learned in class, initiated fruitful interaction sharing the "aha moments" with students both during my lecture and office hours, and witnessed students' thrill of accomplishment applying their knowledge to gain hands-on experiences which in turn reinforced their understanding. It was highly rewarding. I firmly believe teaching is about infection rather than injection. Instead of walking through details and potential obstacles in my lectures, I provided inspirational hints which motivated my students to proactively search for solutions.

As a guest lecturer for *ECE 597: Wireless Networks* (Spring'15), I offered graduate students interested in wireless networks an introduction to software defined radios (SDR). I first provided the context of current and next-generation wireless networks to position the critical role of SDR in wireless system research. Taking Wireless Open-Access Research Platform (WARP) as an example, the lecture revealed what SDR can do using an 802.11 WiFi reference design. Students resonated with what they had learned about PHY and MAC layer protocols when I disassembled the entire WiFi stack implementation. I concluded the lecture with some preliminary results of my research and a Q&A session that led to many questions and interactions. I have actively sought out interactions with students to involve everyone in the audience into the discussion. Last February, I was invited to *CSCI 697: Seminar in Computer Science Research* (Spring'19) as a panelist to share advice to new Ph.D. students. When asked about academic versus industry, I was curious and did a show-of-hands of whether the audience has determined even before Ph.D.. This simple interaction immediately pulls the audience closer, which turns the uni-directional sharing into a one-to-many conversation.

In addition to my own teaching experience, I have had the opportunity to observe closely and learn from exceptional instructors. The most impressive course was an operating system class during my early graduate study. I was amazed by how the entire body of knowledge was logically connected, organized, and presented. Every detail was explained under the context of four vertical umbrellas: processor, memory, storage, and communication. General principles (*e.g.* abstraction, indirection, lazy execution) were illustrated everywhere and therefore connected details horizontally across each umbrella. As a student, I was able to connect the dots easily, building a chain of knowledge with everything properly indexed for *fast retrieval*

without memory leakage. The instructor was able to do this not only because of a solid grasp of the entire knowledge base, but also an elegant habit of *recapping* and *forecasting* at the beginning and end of every lecture. Such organization and presentation require careful preparation, but the impact is miraculous.

Mentoring Experience

Part of my enthusiasm to become a faculty member is to form lifelong connections and fruitful collaboration with students through supporting their growth towards successful careers. My mentoring goal is to ignite students' curiosity, fuel their passion, and cultivate the courage to embrace challenges realizing their vision.

Over the past few years, I had the honor to mentor 5 M.S. students, 1 undergraduate, and 5 junior Ph.D. students, as well as be mentored by fantastic role models. This experience taught me three important lessons: *patience, effective communication, and flexibility*. Research can be frustrating. Mentors need to be exceptionally patient in listening and resolving difficulties, obstacles, and complaints. While mentees are taking the actual steps pursuing their goal, an effective mentor is one who is calm, objective, and encouraging when faced with frustrations. I believe successful mentoring is rooted in encouragement and leadership rather than pushing demands and being negative about setbacks. With these mentoring experiences, I have also learned to tailor mentoring styles to different personalities, interests, and stages in the mentees' careers.

Course Development and Seminars

Inspired by exceptional instructors, I am passionate about systematically organizing and presenting bodies of knowledge with carefully designed syllabus. Given an interdisciplinary education, I have the appropriate background to teach both EE and CS classes on introductory and advanced topics including computer communication, operating systems, wireless networks, *etc.* I also aspire to develop new courses and seminars related to two lines of my research, and contribute to the course development initiative in the department.

One topic is *"Cooperative Autonomous Robots"*, where I will discuss state-of-the-art perception and control algorithms, as well as next generation wireless networks and communications. I will design *modular* course projects in the autonomous driving simulator, Carla, and drone simulator, AirSim, for students to build perception-control robots end-to-end. I will also design cooperative driving challenges for students to form teams and compete in navigating vehicles and drones around safety hazards. Through this process, students can gain a full picture of how autonomous robots work today, and innovate ways for robots to cooperate and network, and investigate security and robustness issues in the entire ecosystem.

The second topic is *"Systems for Robust ML"*, where I will combine my experience in Microsoft and Waymo, discuss innovations and open problems in the state-of-the-art machine learning systems in production, both at the edge and in the cloud, such as autonomous driving and live video analytics. In particular, I can use ML-EXray to motivate students to explore hardware-aware model design for Edge ML, and use FourSeasons to create mini-challenges for students to develop models to compete for model robustness over long-term deployment. I can also use Satyam to let students curate datasets for novel disruptive Edge ML applications.

Research Advising

With my mentoring philosophy, I look forward to working with students from diverse backgrounds, fanning their passion, and cultivating their own research tastes and styles. For early-stage Ph.D. students, I would give more direction and guidance with well-defined problems that fit their backgrounds. I value hands-on experience for system researchers to spark new challenges and opportunities and break boundaries. I would help the students find the right toolset, framework, dataset to work with. As a systems researcher, I acknowledge the initial system building overhead before branching out to conduct multiple meaningful research. So I would ensure the inheritance and maintenance of work within research groups, while developing new systems for new topics and foci. After initial success, I would consolidate junior students' confidence to explore progressively open-ended problems to build practical systems with social impact. When students become senior, as a tradition in my research group, I would let them mentor fresh Ph.D. students whose interests fit, to extend current work to new directions. This forms a positive feedback loop to give the proper training in research and mentoring to every student in the pipeline and boosts their success.

With my industry contacts, I will encourage students to do internships that fit their research agenda. I have benefited from my research internships with Waymo, Microsoft, and IBM. The work has contributed to my doctoral thesis, and I continue to work with industry collaborators and receive great advice from them.

In this fast-paced world, I enthusiastically look forward to bringing cutting-edge technologies and my experience to the class, while exploring new frontiers with passionate students, and preparing our future researchers, scientists, and engineers with the expertise needed to contribute to a better society.