Teaching Statement

In the course of my academic journey, I have had the privilege of mentoring and collaborating with a diverse group of students at various levels, from undergraduate to Ph.D. candidates. My approach to mentorship involves guiding individuals in identifying research directions aligned with their interests, fostering critical thinking, and promoting creative problem-solving. Through this process, I aim to instill a passion for exploration and a commitment to excellence in their academic pursuits.

Teaching Experience: I delivered two guest lectures for a graduate class on Modern Communication Networks and served as a teaching assistant for various courses, including Introduction to Machine Learning (with over 200 students), Internet Architecture and Protocols, and Wireless Sensing. In this role, my responsibilities included designing exams and lab materials, grading exams, and conducting office hours.

I played a key role in creating a new undergraduate class on wireless sensing at UC San Diego. Our primary goal was to offer hands-on experience in utilizing wireless radio-frequency signals for sensing tasks, such as locating individuals and monitoring their breathing and heart rates. While designing this class, I ensured that students not only acquire theoretical knowledge, but also apply them through labs and projects. To achieve this, I developed labs with coding exercises, incorporating both simulated and real-world datasets that increased in complexity as the class progressed. As a final project, we provided software-defined radios for each student to take home, enabling them to collect their own data for estimating breathing and heart rates. Under my guidance, students produced remarkable results, even surpassing our expectations by implementing advanced techniques such as Kalman filtering to improve sensing accuracy in practical, real-world environments.

Acquiring practical knowledge through research projects is even more important for graduate students. When I was TA for a graduate class on Modern communication networks with a 50% project component, I actively collaborated with students, providing guidance throughout their projects. I started by introducing students to diverse research topics on WiFi, cellular, RFID, and radar, aligning these with their interests and prior experiences. For instance, I mentored a student with a background in signal processing to delve into the security of automotive radars and provided access to my millimeter-wave testbed to build a 'spoofing device'. Throughout the class, I emphasized the importance of following rigorous research procedures such as breaking down problems into meaningful tasks, communicating ideas through conference-style paper writing, and evaluating peers' work through a peer-review process. This approach not only instilled confidence in students' research abilities but also yielded tangible outcomes. One student group continued their projects beyond the classroom, eventually shaping them into our paper on mmSpoof, presented at the IEEE Symposium on Security and Privacy.

Over six semesters/quarters of teaching assistance, I honed my teaching skills and qualities. I understand that different students have different learning curves, so I keep patience, listen to their questions carefully, and sometimes take a step back and repeat the fundamental concepts again and provide more practical examples to ensure they understand them well. I also seek active feedback from students and pace myself to align with students. I plan lectures well in advance, organize materials systematically, and incorporate interactive elements like quizzes, group exercises, and class participation to enhance engagement. This teaching style has garnered positive responses from students, as reflected in anonymous reviews[1], such as—

> 10/10 Great TA! Ish was extremely helpful whenever I reached out. He always responded quickly with great responses and very intuitive explanations. Fantastic at communicating concepts and leading students in the right direction for homework's / project.

> Great at explaining things in a simple manner, was very detailed with the two lectures he conducted. He took time out to clarify everyone's questions and has very good knowledge of the subject.

> He is very helpful, and explains everything in detail. He is very patient, and answers doubts very quickly on Piazza.

> Always ready to answer questions and prompt response

> Ish is extremely dedicated and committed to any task he is given and being a TA is no different. He is very diligent, thorough and truly cares that all students he mentors learn from him. He in not only very knowledgeable but also goes beyond expectations to help students resolve their questions. He is available at any time to solve our doubts and answer questions. The best TA I have met in my experience from 3 different graduate schools in the US!

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[1]Teaching Evaluation link https://ishjain.github.io/assets/docs/Ish_TA_Evaluation_ECE257B.pdf

Mentorship Experience: Throughout my Ph.D. journey, I have had the privilege of collaborating with and providing mentorship to three Ph.D. students (Rohith Reddy Vennam, Tian Qiu, and Ushasi Ghosh), six MS students, and three BS students.

My mentoring approach involves a dual focus. Firstly, I closely collaborate with my mentees to identify potential research directions that align with their interests and skills. I consistently motivate them by illustrating the broad impact of their research and refining abstract ideas. To illustrate, an undergraduate student, Raini excelled in building and programming large-scale code in C/C++. I mentored him in creating a real-time VR processing pipeline using the DASH protocol. This platform proved instrumental in evaluating our work on a novel VR video compression algorithm, achieving a remarkable 1000x speed improvement compared to a previous Matlab-based implementation. Raini co-authored a paper for WPMC 2022 during his undergraduate studies and subsequently pursued a PhD at UC San Diego.

Secondly, I guide students to cultivate critical thinking and creativity in both their ideas and implementations. I advocate for an approach that steers away from spoonfeeding——instead of providing immediate solutions, I offer directions to encourage independent, critical thinking. Embracing mistakes in initial attempts is part of the learning process, as it fosters a deeper understanding and retention of knowledge over the long term. For example, while mentoring an MS student, Frederik, who possessed a strong background in higher layers of the networking stack but lacked experience in the PHY layer, I provided guidance by explaining the connection between the two layers. Through this support, he not only acquired knowledge of PHY but also implemented it using an end-to-end cellular stack. Frederik presented a real-time demo at Milcom 2023, published BeamArmor paper in Hotmobile 2024, and the overall experience fueled his motivation to pursue a Ph.D. at ETH Zurich.

Courses I aspire to Teach: I am well-prepared and enthusiastic about teaching a range of graduate and undergraduate courses such as Signals & Systems, Linear Systems, and Digital Signal Processing. I can also teach advanced classes, such as Wireless Communications, Digital Communications, Computer Networks, and Machine Learning. I particularly enjoy teaching these classes because they not only possess intriguing mathematical foundations but also because my research experience has provided me with a deep understanding and intuition in these areas.

I would like to introduce a lab-based class on **Modern Wireless Communication and Sensing** as a special topic that will focus on emerging communication technologies, including Millimeter-wave and THz networks, Non-terrestrial networks, Massive MIMO, and the Internet of Things as well as Wireless Sensing applications such as gesture recognition, human activity detection, sleep monitoring, and tracking. I plan to design hands-on labs where students will have the opportunity to work with wireless software-defined radios such as USRP and PlutoSDR, allowing them to design and construct end-to-end receivers for OFDM/MIMO-based communication and sensing systems. My prior experience as a teaching assistant for Modern Communication Networks and Wireless Sensing equips me with the necessary expertise to effectively design and instruct this class.

Leadership and Outreach: My commitment to leadership and outreach has been an integral part of my academic journey. In the early stages of my Ph.D., I took the initiative to establish a reading group among graduate students spanning two labs at my university. Every week, we would meet and discuss a relevant paper in the area of wireless networking. This initiative evolved into the *O.W.L Reading group*[2], reaching an international scale with over 50 participants from across the globe. Simultaneously, as the vice president of the graduate student council, I organized a departmental seminar series, inviting over 20 professors and local start-ups to present technical talks at UC San Diego. Beyond campus, I engaged in the K12 Escribamos Ciencia program, collaborating with Prof. Olivia Graeve to develop engaging science modules and videos for K12 students in Tijuana, Mexico.

I also actively participate in academic services. I volunteered on artifact evaluation committees for conferences such as Sigcomm'23, Mobicom'23, and CoNext'19 and provided technical reviews for conferences and journals like IEEE Transactions for Vehicular Technology and IEEE Communication Letters. In my role as co-chair for the ACM S3 workshop in Madrid, Spain, I played a pivotal role in the overall organization, from forming the technical review committee to overseeing paper submissions and orchestrating technical sessions and panels. Looking ahead, I am enthusiastic about extending my outreach efforts, extending mentorship and support to connect with a more extensive academic community, and fostering collaboration and inclusivity.

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[2]O.W.L Reading group: https://owlwireless.github.io/