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Teaching Statement

My passion for teaching stems from the pursuit of knowledge and the chance to witness young students' intellectual growth. It is therefore imperative to bring excellence to the classroom. In this teaching statement, I will highlight some guidelines that I shall uphold as a teacher. I also describe previous teaching experience, both in the classroom as well as through mentorship. Finally, I will talk about courses that I am excited to teach as a faculty.

Teaching Philosophy

I'm a strong advocate for teaching fundamental concepts from first principles, incorporating mathematical rigor where it adds value. This approach is essential for nurturing highly capable engineers and scientists who can adapt to rapidly changing technological landscapes. My self-taught background in Computer Science, ECE, and Math positions me uniquely to blend the best elements of each, offering a holistic and rigorous educational experience.

A core aspect of teaching is to ensure that students are engaged outside of the classroom as much as they are inside. I will include problem sets and exercises as part of the homeworks that include numerical questions, coding assignments, as well as critical analysis tasks, among others. Each category of question will aim to test and develop different skill sets. For instance, numerical and coding based questions will test the technical grasp whereas critical analysis questions will develop independent thinking. Furthermore, there will be a clear distinction between exercises and problem sets. The former shall reinforce the topics taught in class whereas the latter shall test whether students can apply those topics in different settings.

Lastly, I am excited to implement a pedagogical device in my class where students will break out into groups and will teach their peers a course-related topic that they are comfortable with. The premise is that people learn new topics most effectively by teaching it to someone. So, in addition to the homework assignments, this in-class exercise will cement the course content into the students.

Prior Teaching Experience

My passion for teaching manifested since my college days. Whenever I returned home on weekends, I eagerly took on the role of teaching high school math to my 9th grade neighbor. My role as a teacher in this instance could affect how she interpreted math in later years. I was delighted to learn recently that my mentoring inspired her to pursue a career in STEM; she is currently a rising sophomore in computer science in the US. Then during my masters at the University of Maryland, College Park (UMD), I taught my brother, who was an undergraduate student at UMD at the time, introductory calculus and statistics. He is currently a signals intelligence officer in the US Marine Corps.

During my time as a Teaching Assistant (TA) at the UMD, I consistently applied my teaching philosophy while assisting undergraduate classes in discrete mathematics (CMSC 250) taught by Mr. Jason Fillippou, programming fundamentals (CMSC 131) taught by Mr. Fawzi Emad, and computer networking (CMSC 417) taught by Dr. Ashok Agrawala. In these courses, my responsibilities included teaching sections, grading, and holding office hours. Each section comprised about 30 students, and I always made it a point to remember each student's name. Even as a TA, I brought my personal philosophy to these sections and the results are reflected in my teaching evaluations. These experiences fueled my passion for teaching and inspired me to explore alternative and engaging teaching methods. For instance, I once taught a discrete math class using Pokémon as a teaching tool, illustrating concepts like functions and relations through a mapping of Pokémon and their types. This creative approach proved to be both effective and enjoyable for the students, fostering a deeper understanding of the subject matter. In my grading, my core objective was to fairly and accurately mark the student's work. This is trickier than one might imagine as it involves striking a fine balance between strictness and leniency, veering too much towards either direction is harmful to the student in the future. Finally, my office hours typically turned into teaching moments as my process never involved feeding students the answer, rather, I used to guide them to it by hinting towards the solution.

Lastly, as part of the Future Faculty program at UMD, I spent a semester-long seminar that helped sharpen my teaching skills and put them to practice. The program was different from my experience as a TA in that here, I taught graduate level topics to an audience who would then critique and provide feedback. Such a feedback-driven seminar acted like a crash course on improving one's teaching skills. More specifically, I learned crucial aspects of timing–when I engaged the audience and when I started to lose them. I also learned about preparing materials and realized that certain materials that I understood were not necessarily legible to my peers. Lastly, I learned the importance of tailoring the type of exercises according to the class. For instance, a take home assignment might make sense for classes heavy on critical analysis whereas in-class assignments make more sense for computing-based courses.

Mentoring

My experience as a TA equipped me with the skills to effectively address students' questions and concerns, thereby preparing me to mentor graduate students when they sought technical guidance from me. During my time as a Ph.D. student and a postdoc at UMD and UT Austin, I had the opportunity to advise a diverse group of students consisting of one undergraduate, two master's students, and four doctoral students. These students came from various backgrounds and had different career goals. My mentoring style focused on creating a safe learning environment where students felt comfortable asking questions and discussing negative results during our weekly

meetings. I tailored my advising approach and set specific objectives based on the individual needs of each student. Here are two examples of students I mentored:

- Divya Kothandaraman began her PhD at UMD in March 2020 with Dr. Dinesh Manocha at the onset of the COVID-19 pandemic. The PhD journey is a hard one even in the best of times in the best environments. I can only imagine the hardship for a student starting a remote Ph.D. from a different country amidst a global pandemic knowing that they would have to physically and culturally transition to the U.S. mid-PhD once the pandemic subsides. I supervised Divya's initial research in unsupervised domain adaptation for semantic segmentation in unstructured traffic environments, which resulted in her first two papers at ICCV 2021. After these two projects, she became independent and successfully went on to publish three first author papers in ECCV 2022, WACV 2023, and ICRA 2023, along with several co-authored papers.
- Tianrui Guan started out as a masters student with me. Since he was new to research, I had him contribute to my ongoing work at the time as a co-author. During this time, I regularly met with Tian and showed him firsthand what carrying out research as a first author looks like. Tian then went on to continue his PhD with Dinesh where he has published four papers in ICRA 2023, RSS 2022, WACV 2022, and RA-L/IROS 2022, along with several co-authored papers.
- Xiyang Wu is a current advisee who is pursuing a Ph.D. at the University of Maryland, College Park. I helped him publish his first paper in the Proceedings of Machine Learning Research. This paper was additional presented as an oral paper (6% acceptance rate) at the Conference of Robot Learning (CoRL) this year. I advised Xiyang through the writing, analysis, submission, as well as rebuttal processes and we currently brainstorming follow-on projects.

For undergraduate students, my modus operandi is to have them work on a "starter project" which is basically a course project level assignment that they have to make progress on in two weeks. In these two weeks, my goal is to assess their diligence, ability to follow up, ask the right questions, and make decent progress. Such an exercise proved particularly useful as UG students often have a high variance in terms of productivity, so these exercises enable me to understand the correct approach toward different UG students.

Teaching as part of STEM Initiatives

Furthermore, I have actively engaged in educational programs such as AI4ALL and NYU AI School. In these programs, I taught machine learning and programming to high school students, particularly those from underrepresented minorities. By guiding them and discussing career paths in machine learning research, I aimed to break down barriers and empower individuals to pursue their interests and aspirations. I have additionally organized hands-on robotics activities where I helped students practically deploy a robot and navigate through an obstacle course made out of cardboard boxes and household objects such as chairs and tables.

Future Teaching

In addition to undergraduate courses, I propose teaching graduate courses related to **robotics, optimization, and planning and decision making**. I believe that these courses build upon essential foundations in mathematics and computer science and also offer practical applications in various fields. For example, optimization serves as a logical progression from linear algebra and calculus, while optimal planning and decision-making involve finding sequences of controls that optimize specific cost functions, drawing heavily from optimization techniques. I plan to build the core of my courses using materials from Planning Fundamentals by Steven LaValle, Convex Optimization by Boyd and Vanderberghe, and Mathematical Control Theory by Sontag, having learned from these books myself. Additionally, I will adapt supplementary material from numerical optimization and numerical linear algebra from Wright's Numerical Optimization and Demmel's Numerical Linear Algebra. What makes my course unique is the blend of optimization, multi-agent systems, and robotics. Most CS or engineering departments separate courses from these topics. On the other hand, I can design a course that not only teaches the fundamentals from these three disparate areas, but can also show how they come together. Alternatively, if convenient for the department, I can split my material into a 2-semester course, offering one in the Fall and the second in the Spring.

Additionally, at the undergraduate level, I am equipped to teach a diverse range of math courses, from calculus to linear algebra, including computer science-aligned courses like discrete mathematics. In particular, I am interested in teaching applied linear algebra closely mirroring the material from Gilbert Strang's classic texts. In addition to teaching courses with a strong theoretical background, I am also equipped to teach courses involving hands-on robotics experience. During my postdoc at UT Austin, I participated in the BARN Challenge which is a single agent static environment obstacle course completion competition. The task is to have a Clearpath Jackal navigate safely through a maze built out of cardboard boxes as quickly as possible. Although our team focused on this task from a competitive focus, I plan to use the extend and develop the codebase used for the BARN challenge as a coding environment for students to learn various aspects of the robot navigation pipeline.