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Teaching and Mentorship Statement

Through my academic journey, I have been privileged to have outstanding teachers, supervisors, and mentors. They have played an instrumental role in influencing my academic and research trajectories. Through actions and instruction, I also believe that they have inspired a strong sense of societal responsibility in me. As a prospective STEM educator for the next generation of engineers, I believe that I have a duty towards my students and society to not only set the right example through my actions but also to facilitate the development of ideas of academic integrity and ethical and social responsibilities in my future students and mentees.

Teaching

During my undergraduate studies, I majored in aerospace engineering with a focus on control systems; and during graduate school, I further specialized in autonomous systems, machine learning, and interaction between humans and autonomy. Through my Ph.D. research, I have also acquired expertise in formal methods, probabilistic modeling, and human factors. I believe that my rigorous coursework, research experience, and strong fundamentals of mathematical concepts like linear algebra, real and complex analysis, and calculus make me well suited as an instructor for courses dealing with the design of autonomous systems and their interactions with human users.

In the past, I have served in various formal and informal teaching roles. I served as the aeromodelling club chair at the Indian Institute of Technology - Bombay (IIT-B), where one of my initiatives was conducting a semester-long structured workshop for designing, building, and flying model aircraft for first-year engineering students. I taught fortnightly technical sessions aimed at aircraft sizing, flight mechanics, aerodynamics, and flight controls. In my experience, the student teams responded very well to the interweaving of theory and hands-on sessions and came up with successful design solutions, quite different from the reference design we provided.

I was a teaching assistant for the undergraduate class on classical control theory at MIT. My responsibilities included designing the weekly problem sets and supporting recitations for the class. Along with problems based on traditional problem-solving approaches, I also tried to include challenge problems that typically did not satisfy the assumptions required for approaches to work. I designed the questions to guide the students through the process of testing for the validity of assumptions and recognizing where the methods taught in the class failed. During that edition of the class, we also experimented with an arduino-based hardware platform to ground the concepts covered in the class, culminating in a final competition on a track that required line-following, dead-reckoning, and bearing-following elements.

A particularly formative experience that impacted my teaching philosophy was attending the Kaufman teaching certificate program (KTCP) at the MIT teaching and learning lab. This program involved a series of interactive workshops on evidence-based teaching. The key takeaway from the workshop for me was the merits of applying Wiggins and McTighe's [2] backward design principles at all levels of course development – from the syllabus to the planning of individual class sessions. The principle of nurturing a growth mindset in the students was another key influence. Such a growth mindset engenders the belief that command over the course materials can be continuously improved through effort.

Based on my experiences as a teacher and a learner, I would like to bring about the following changes in classroom teaching. I have found that familiarity with prerequisites is crucial in aiding learning outcomes in interdisciplinary classes – particularly in human-factors, autonomous systems, and human-machine interaction. As an instructor, I will pay special attention to provide the students a scaffolding through appropriate formative assessments, and active learning activities [1] to help students assess their command over the prerequisites and take action to address the gaps. Next, I believe that it is important to teach the students about the gap between known theory and industry practice. In machine learning and data science, the industrial practices venture farther away from known theoretical results. I plan to accomplish this by designing summative assessments that are authentic to real-world applications in each unit of my class. Finally, I have benefited tremendously from the availability of free and open-source software packages in classroom and research settings. I will try to ensure that all required software for my classroom purposes is available under free or open-source licenses. I will include a short module in all my courses on the implications of various free or open-source software licenses and encourage the students to release their code developed for class projects under an appropriate license.

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have realized that a well rounded STEM education must not be based purely on a technical foundation. Autonomous systems are projected to be commonplace in near future, and the socio-economic realities of the world must have a direct bearing on the design and development of such systems.

Following the evolving landscape of human-centered autonomous systems and robotics in academia and industry, I realized that well-rounded STEM education must not be based purely on a technical foundation. Autonomous systems are projected to be commonplace in the near future, and the world's socio-economic realities must have a direct bearing on the design and development of such systems. I will ensure that social and ethical considerations relevant to the class's technical content will also be part of the learning objectives for all my courses.

I will be an ideal candidate to teach classes pertaining to control theory, autonomous systems, human-factors, and statistical methods for experiment design. For graduate students, I plan to develop a new course on robot learning inspired by human-factors research. A project centered on identifying new research directions and creating a research plan would be at the core of the class.

Mentorship

I have had the utmost privilege of having outstanding and supportive mentors during my undergraduate and graduate studies. Having experienced first hand the outcomes of nurturing, supportive and respectful mentors, I believe I must provide the same environment to my mentees.

My first experience as a mentor was my involvement with the student-driven small satellite initiative as IIT-B. One of the project goals was to develop all of the flight hardware – from structural elements to circuit boards– in-house. Consequently, the project's life-span was longer than the undergraduate tenure of any of the student members. As the lead for the attitude determination and control system, I supervised a team of second and third-year students in developing the control law and verification and validation simulations. But at the same time, I was also responsible for training them to lead the team after my graduation. Pratham, IIT-B's first student satellite, was launched during the tenure of my successor. Today, IIT-B's student satellite initiative is lead by the fourth generation of team leads and is working towards completing its second satellite.

During my Ph.D., I was fortunate to work with six undergraduate researchers on projects ranging from perception, machine learning, data abstraction, and planning. It was an enriching experience to work with students from diverse backgrounds, majors, and from first-year to seniors and contribute to novel research. One of my undergraduate research advisees is currently in graduate school, focusing on artificial intelligence, and others have transitioned to industry positions ranging from robotics to software engineering.

Through my experiences as a mentor and a mentee, I have realized that there is no single approach to mentorship. I will adopt an advising style tailored to an individual student. I will set calibrated research challenges for the students, and as the students start gaining more autonomy in synthesizing research ideas, I will allow them the freedom to do so. I will be committed to promoting appropriate work-life balance for the members of my research group, encouraging them to ensure that they include personal and leisure time in their plans.

As an international student in a new country, I was fortunate to be a member of a diverse and extremely welcoming research group. Through my time in the United States, I have also tried to educate myself regarding the structural and systemic inequities that exist, and I strongly believe that educators and senior members of the research community must take a proactive approach to address them. On my part, I have actively participated in outreach programs like the Cambridge Science festival and special programs through the MIT UROP office. I have also lead and participated in giving lab tours and devoting time to meet with prospective graduate students who are interested in the field. As a faculty member, I will continue and expand my contributions towards promoting STEM education to underrepresented groups.

As a future member of faculty, I will keep myself updated with the best practices in pedagogy and continuously update my teaching methods in step with it. I will include the social and ethical considerations of technological development as a part of all the classes I teach. I will also ensure a diverse, inclusive and welcoming environment within my research group and will be an active enabler of the same within the university and the broader community.

[1] - Richard M Felder and Rebecca Brent. *Teaching and learning STEM: A practical guide*. John Wiley & Sons, 2016
[2] - Grant Wiggins and Jay McTighe. *Understanding by design*. ASCD, 2005