Teaching Statement
Soumyadip Sengupta

Teaching and mentoring is an important part of an academic career. It provides an excellent opportunity to engage young minds that will become the next generation of engineers and scientists and will make a huge impact on society. My teachers inspired and motivated me to pursue a career in academia. In the following I will discuss my teaching philosophies and my experiences in teaching and mentoring.

Teaching Philosophy

Encouraging empathy and compassion. Scientists and engineers coming out of our classrooms will take a leading role in the society and will reshape the world. Thus it is very important to encourage these students to be empathic and compassionate human beings. As a teacher, one cannot ignore how injudicious applications of various algorithmic systems (especially AI) have directly brought harm to several communities throughout the world. I will encourage my students to be mindful of the harmful impacts of AI by instructing them to present possible negative implications of their course projects and ways to mitigate them. My lectures will cover different topics on ethics and bias in Vision and Graphics, e.g., ‘Bias in facial recognition systems’ by Joy Buolamwini and ‘Anti-Racist Graphics Research’ by Theodore Kim.

Creating a safe learning space with focus on interaction and collaboration. In my view, students learn better in an interactive and collaborative environment, where they don’t feel like they are competing against each other. My classes will be designed to encourage collaborative efforts with open ended homework, small group projects, and extra credit for classroom discussion. I will also stress on inter-disciplinary collaboration by encouraging students with diverse technical expertise to form a team for the group project. A safe learning space is very important to foster a collaborative environment. It is important to create an environment where a student can ask any question during the lecture. I will pause intermittently during the lecture to encourage students to ask questions in person or via various anonymous feedback apps.

Developing strong fundamentals and intuition. While Computer Vision and Graphics requires heavy programming knowledge, the field is based on solid mathematical concepts. In my course, I will focus on building a complete horizontal understanding of a topic by developing the mathematical foundation while providing intuitive reasoning and practical examples. For example, Principal Component Analysis (PCA) is a central topic in many vision and learning courses. I will start by revisiting the fundamentals of eigen decomposition and then show the visual depiction of PCA in practice, e.g. in human shape modeling (SMPL model). The homework will include both mathematical problems and coding projects to help connect theory with practice. This will also help the students connect the course material with broader research activities.

Teaching and Mentoring Experience

Teaching Experience. At the University of Maryland, I served as a teaching assistant for a senior level course ‘Communication Systems’ (ENEE 420) and a sophomore level course ‘Discrete Signal Analysis’ (ENEE 222). I adapted my pedagogy for senior and sophomore levels to best fit students’ interests, e.g. in the sophomore level I put more emphasis on depth by often repeating the same theory with different sample problems. On the other hand, for senior levels my aim was to increase the breadth by covering more topics to provide a broader view of an advanced subject. In both these courses, my challenge was to build strong mathematical fundamentals with intuition and practical examples. To that end, I designed the weekly
recitation session to solve a problem, by first motivating it with a real-world example familiar to us. I then encouraged the students to think about the nature of the solution without mathematically solving it, in hope to develop their intuitive skills. Finally, I worked out the mathematical solution, if needed implement it with a Matlab code, and connect it with our intuitive understanding of the problem.

At the University of Washington, I focused on teaching and outreach programs to encourage undergraduate students, especially from under-served and under-represented communities, to become more involved in CV/ML research. I co-organized a CV/ML workshop in October 2021, where I gave an introductory lecture on Computer Vision and research opportunities in it. In the lecture I urged the students to be mindful of the negative impacts our research can cause on the marginalized communities. This lecture was followed by a half day workshop with small groups focused on hands-on programming experiences. In Spring 2021, I served as a mentor for four students (primarily from HBCUs) for a two day virtual workshop, where we worked on applying my research on Background Matting to videos captured with moving cameras. In all these workshops I allocated some time for one-on-one sessions to answer any individual doubts, about getting involved in undergraduate research, applying to grad school, etc.

**Mentoring Experience.** During my doctoral and post-doctoral career at UMD and UW, I am fortunate to advise six undergraduates, four masters and six doctoral students. These students come from various backgrounds with different career goals. My mentoring style is focused on creating a safe learning space, where the students feel free to ask any questions and discuss negative results during weekly meetings. I also developed different advising styles and set separate objectives solely focused on the need of an individual student. Here I highlight few examples of the students I mentored.

Daniel Lichy started out as an undergrad, working with me at UMD, and continued as a doctoral student in my PhD advisor’s group. Daniel comes from a very solid theoretical background in Applied Mathematics with limited experience in practical aspects of Computer Vision and Graphics. I motivated Daniel to work on Inverse Rendering problems, which requires solid mathematical foundation but demands high-quality practical results. I helped him gain confidence in using Deep Learning frameworks and Computer Graphics engines with more hands-on mentoring. As a result we published a paper that produced high-quality results with interesting mathematical insights in CVPR 2021, and another in the TPAMI journal.

As a postdoc at UW, I was asked to mentor Roy Or-El, a doctoral student, who was stuck for more than a year on a challenging research problem of synthesizing facial aging from 0-70 years old. I played the role of day-to-day advising, discussing, and analysing with him the experimental plans and results. I helped him keep track of our broader goal by prioritizing certain directions over others. In the end, Roy was successful in solving the problem and produced high-quality facial aging results, which were published in ECCV 2020.

Andrey Ryabstev and Peter Lin, then seniors and part of BS-MS program at UW reached out to me separately for their MS Thesis Research. They worked jointly and published ‘Real-Time High-Resolution Background Matting’ in CVPR 2021, which received Best Student Paper Honorable Mentions (Top 7 of 7000+ submitted papers) award. In this project I played the role of a primary advisor defining the project, setting goals, conducting weekly meetings to track our progress, and teaching them how to write a paper for a top tier venue like CVPR. Andrey and Peter joined Google and Microsoft respectively after graduation.

**Teaching Interest:** My unique background with bachelor’s degree in electrical engineering and doctoral thesis on Computer Vision and Graphics allows me to teach a diverse group of courses. I look forward to teaching graduate and undergraduate level courses in computer vision, computer graphics, machine learning, artificial intelligence, and signal processing. I am also interested in designing new courses for graduate and undergraduate degrees. For example, I am interested in designing a project-based course for graduate students at the intersection of Computer Vision and Graphics, ‘AI for Content Creation and Editing’. The course will first cover fundamentals about image formation and rendering, followed by more advanced topics like GANs, Neural Rendering and Neural Radiance Fields (NeRFs). It will involve regular coding homework followed by a final group project and presentation.