Teaching Statement

Joshua A. Kroll (kroll@berkeley.edu)

I've had a lifelong love of learning that crosses a broad range of subjects, and have always taken particular joy in sharing knowledge with others. Whether in high school, where I spent over one thousand hours volunteering at the Monterey Bay Aquarium teaching guests and new volunteers about marine science or at the startup I worked at following graduate school, where I taught a weekly orientation course for all new employees and a monthly detailed seminar on company-specific tools for new software engineers, I am always eager to find new opportunities to engage others in the delight of discovering new ideas.

Teaching Experience

I have been a teaching assistant both at the undergraduate and the graduate level, covering both large introductory courses (Harvard's Math 23, a freshman course for those interested in quantitative majors, where I was also course head of six staff; Princeton's Computer Science 226, an introductory algorithms and data structures course) and upper-division, subject-oriented courses (Princeton's Computer Science 432, Information Security). In order to continue teaching during my research-oriented postdoc, I have volunteered guest lectures in a variety of courses as well (notably in Berkeley's Data Science 100, an advanced introduction to data science, where I pioneered the lecture on data ethics, which I have given in three separate semesters).

My training across a variety of quantitative fields equips me to teach a wide variety of courses on technology, public policy, quantitative methods, statistics, or which have a mathematical component. As a computer scientist, I am capable of developing or taking on courses such as: algorithms and data structures; theory of computer science; data science or statistics; machine learning; operating systems; information security and privacy; distributed systems and databases; technology policy; and data ethics. My mathematical background enables me to teach statistical methods courses or data analysis and modeling courses. I am also eager to develop new courses and seminars complementing existing offerings on cybersecurity (either from the technical or the policy perspective), or around building trustworthy technology in a responsible and ethical way.

Finally, my experience in the software industry gives me an excellent basis for which to make courses relevant to tech industry job skills and to teach students about career options.

Teaching Philosophy

I believe that all students deserve the chance to engage with presented material, meaning that when material is dense, technical, or belies students' intuition, it is an instructor's responsibility to make that material interesting, engaging, and relevant for students while encouraging all students to approach it in the way which is most fruitful for them. Some students learn well from structured notes and presentation, while others need demonstrations, visualizations, or examples. Still others need experiences, projects, and problem sets or discussions and engagement with peers. I do my best to determine which modalities best suit particular types of material, with the understanding that many modalities should be used to successfully make material accessible to the broadest set of students. I have also found that it is critical to engage students' own interest in the material early on, to encourage them to think about it on their own, beyond what is presented in class or prompted in assignments and exams, and to make students invested in their own learning. Finally, it is important that all students feel able to learn and comfortable to contribute to a classroom environment. I believe it is important to foster these feelings, especially in students for whom they might not be forthcoming.

Lessons should be engaging for students. That means making the material relevant to their lives, connecting it to applications, demonstrating how it might come up outside the classroom, and situating ideas in a real-world context. For example, when teaching an introductory algorithms and data structures course, I had students in my section take turns presenting the sort of programming "puzzle" problems used in a particularly common sort of software engineering interview, because these problems relate both to the material of the course and to the students' desire to get jobs in the summer and after graduating. I also believe in ensuring that presentations are energetic and intriguing by featuring examples, jokes, interactive elements, and discussions among peers. For example, when teaching a section of an introductory math class where some students were seeing mathematical proofs for the first time, I opened my first class with the most interesting mathematical proof I could think of, Georg Cantor's proof that there are more real numbers than integers. These approaches show the material to students, rather than simply telling them about it.

With technical material, it is important to help students find their footing and confidence. I have had multiple students who came into classes very afraid of the material, have worked closely with them, and had them perform very well in the courses. One student in the introductory algorithms course for which I was a TA, a first-year woman who expressed profound anxiety about all of the assignments and exams, even became a Computer Science major afterwards and went on to be awarded several departmental and university-wide honors, prizes, and post-graduation competitive fellowships. Students are most confident when they are prepared with appropriate background material, are challenged but not confused by new material, and have ample opportunities to raise questions and concerns to course staff.

Technology must be thought of within a human context - technical choices represent and shape human values, goals, and norms. For this reason, I believe ethics and social consciousness must be a part of all material, not relegated to a separate course or lecture. After pioneering the lecture on data ethics in the UC Berkeley advanced introductory data science course, I worked with the course staff to bring ethics content into material across the class, engaging students across assignments, lectures, and course projects. Additionally, while teaching Information Security, I built ethics and responsibility into the rubric of the final assignment, the simulated forensic analysis of a computer belonging to a suspect in a murder case. Students must understand not only how to find answers abstractly, but what those answers mean in the real world.

Finally, I have found that students are most engaged with material when it is presented at the level of detail they seek. When teaching an introductory math course aimed at freshmen interested in quantitative majors, many students were frustrated that the applied nature of some of the course material was crowding out interesting-but-more-theoretical ideas covered in classes geared towards math majors (because the structure of the course offerings left many students to wonder if they had chosen the correct level for their interests). To remedy this, I voluntarily gave a well received optional three-hour lecture at the end of the course, re-developing all of the mathematics we had covered at a more abstract level, based on the treatment used in the class designed for prospective math majors.

Mentoring Philosophy

I have benefited greatly from dedicated mentors through my career, and hope to give to others what was given to me: supportive and engaging opportunities to work on research that stretched my abilities while allowing me to make meaningful contributions. I have had opportunities to mentor others, and have found it a rewarding experience every time.

In graduate school, I mentored a group of undergraduates through a summer in a program to help them overcome their lack of computer science experience and background and become fully integrated members of the computer science department's undergraduate cohort. The students designed and implemented an electronic voting system which requires only paper ballots and mobile phones to operate, but which nonetheless gives security and privacy properties in line with best-of-breed commercial technologies. The experience gave me the chance to help students see through a complete project and achieve the satisfaction of a successful demonstration prototype, while also tying an important educational opportunity for students to cutting-edge research and thought in cybersecurity, my research focus at the time.

As a postdoc, I have been fortunate to work with and mentor a first-year graduate student at the UC Berkeley School of Information, with whom I have given multiple tutorials at top-tier conferences, presented well-received papers, co-lectured, worked on a social impact project, and submitted a regulatory comment to the Federal Trade Commission. Our collaborations are fruitful precisely because we shape them to maximize our shared interests while complementing each other's backgrounds and knowledge. I have found that it is important to be open to learning as a mentor as well, and to be able to see mentored students as whole persons who can grow to become peers.