Teaching Statement

Kevin Sun, June 2022

As a graduate student in computer science at Duke University, I taught the undergraduate algorithms course (CPS 330) as Instructor of Record, and both CPS 330 and discrete mathematics (CPS 230) as a Teaching Assistant (TA) multiple times. These courses are somewhat unique in the computer science curriculum since they do not involve major programming assignments. Instead, the goal of these courses is to foster the ability to reason about abstract concepts, formally prove mathematical statements, and design solutions to problems in computer science.

As a TA for both courses, I helped write and grade assignments, and answered many student questions on Piazza, an online platform for course communication. But I spent most of my time directly interacting with students, by leading multiple weekly recitations (approximately 20 students each) and holding office hours. These interactions gave me a close understanding of students' backgrounds, tendencies, and desires. With this understanding, I felt motivated to teach CPS 330 as instructor in Summer 2021.

During my term as instructor, I made a number of decisions that I believe improved student learning, including the following:

- During the prior semester, I wrote a mini textbook on algorithms. As a TA, I had received many questions from students about what constitutes a "proof" and how much is "enough." In response to these questions, I wanted to provide a selection of solutions and proofs that students could use as a reference. One student described the mini textbook as "a good baseline for formatting [their] homework assignments… how proofs should be structured, what information is necessary, etc." Other students have expressed similar gratitude for this resource, including some outside my class.

- Since my class was fairly small (21 students), I was eager to implement peer instruction after seeing the compelling research that demonstrates its benefits. To do this, I broke my lecture up with clicker-style quizzes, polled students for their initial responses, had them discuss in groups, and polled them again for their final responses. Students appreciated this distributed, peer-based style of teaching, and their responses improved every time.

  Peer instruction is also a natural pedagogical tool given the content of the material. The heart of the courses I've taught is the mathematical proof: a sequence of logical steps that formally demonstrates the validity of some precise statement. But inevitably, there is some ambiguity about this definition – a professional mathematician can take much larger "steps" than a budding student. However, the point of a proof is to communicate an idea to someone else, so working in groups is a critical learning activity.

  Whenever my office hours got unusually crowded, I encouraged students to discuss their proofs among themselves. Not only did this allow me to use my time more efficiently, it also cemented students' understanding of their own solutions. On top of that, these discussions generated camaraderie among the students, which boosted their enthusiasm and motivation.

- I experimented with giving every student the option of an oral final exam, instead of a written one. In my experience, written exams can prevent students from fully demonstrating their mastery of the material. Without any feedback whatsoever, students often resort to scribbling relevant words and hoping for the best, or writing nothing at all, even when they actually do have some understanding of the material. Furthermore, since the course was taught entirely online, I made extra efforts to encourage academic integrity, and a long written exam might have undermined these efforts.

  In contrast, oral exams allow students to practice their ability to think on the spot and demonstrate their mastery of the material in a more organic and structured way. Again, I was fortunate that the class was fairly small, so it was viable for me to individually meet with every student. In fact, I offered students several opportunities throughout the term to take a mock oral exam, and most of them gratefully accepted. Overall, I believe my experiment was a success, and I even wrote an *Inside Higher Ed* piece about it.

- My overall philosophy is that, as a teacher, I should strive to meet every student where they are, not where someone thinks they "should" be. Too often I have seen long lectures fly over students' heads because the instructor was not aware of their audience, and this damages both student learning and morale. So during my semester as instructor, I regularly received student feedback (sometimes anonymized), encouraged them to be honest, and adjusted my teaching accordingly.

Development and Future Goals

At Duke, I participated in various programs to develop my teaching practice and philosophy. In particular, I've taken classes and been observed by my peers as part of the Certificate in College Teaching program. I was also selected for the Teaching on Purpose fellowship, which involved weekly discussions on helping undergraduates flourish. In the coming years, I hope to continue exploring the role of higher education and the impact of computer science on society.

More concretely, I aspire to motivate the course material in a way that captures students' interests. I understand that many students find mathematics rather dry, so I would like to draw stronger connections with topics they find more interesting, which could include computer programming, economics, or even politics.

In fact, I believe that the formal reasoning skills taught in discrete mathematics are beneficial in nearly every human endeavor. Basic logic, proof techniques, and probabilistic thinking form some of the foundations of what it means to think critically about a problem. Thus, in the future, I hope to develop a course for all undergraduates interested in this mathematical way of thinking, with applications to a range of fields beyond computer science. As the problems we face in the world require increasingly interdisciplinary solutions, and technology continues to proliferate, I believe a widespread understanding of core concepts in mathematics and computer science would benefit everyone.