TEACHING STATEMENT

KISHOR JOTHIMURUGAN
keyshor.github.io

Teaching is one of the most enjoyable experiences as an academic and I will strive to be a thoughtful, inclusive, and considerate teacher who is effective at imparting knowledge to students. During my time as a doctoral student at the University of Pennsylvania, I have had the opportunity to be a guest lecturer a couple of times, a TA for an undergraduate as well as a graduate course, and have mentored a few graduate students. I was also issued a *Teaching Certificate* by the *Center for Teaching and Learning* (CTL) at the University of Pennsylvania for undergoing graduate training in teaching. During my undergraduate studies, I served as a TA for two courses and held multiple tutorials for my peers which helped strengthen our collective understanding of various concepts.

Teaching Philosophy

I believe that learning is a process of *rediscovering known concepts and ideas*. More often than not, students are unaware of the context and history behind the concept they study which might make its invention seem mystical to them. Instead of simply presenting existing knowledge, my teaching style involves guiding the students to think about how the knowledge came into existence and how they themselves might have created such knowledge. This is usually achieved by providing sufficient hints so that the students collectively form the main ideas behind a concept before I explain it in detail. For example, in a guest lecture, I taught about an algorithm (RELUPLEX) to verify neural networks which adapts an existing algorithm (SIMPLEX) for solving linear programs. I began by introducing SIMPLEX followed by a series of questions that naturally lead to the discovery of RELUPLEX. This way of teaching not only improves retention of the concept being learned but also raises many questions (e.g., alternate approaches), seeking answers to which can lead to a deeper understanding as well as to new research directions. Moreover, this approach demystifies the research process and thereby encourages many students to pursue a career in research.

In general, whenever possible, I like to follow the following steps for teaching any new concept. First, I make sure that the students have the necessary background knowledge to understand the material. I then explain why the particular concept is necessary and what it tries to accomplish at a high level. This is followed by a discussion of ideas from the students that enable attaining the high-level objective, eventually leading to a rediscovery of the concept. Finally, I point out any potential issues with alternative suggestions and encourage students to pursue their ideas as research projects.

I adhere to a few important teaching principles that I have learned from my own teachers. I focus on quality rather than quantity and only aim to cover enough material necessary to equip the students to explore further and learn more about the topic. I strongly feel that assignments should be designed carefully to not only be used for evaluation but also to help bolster the understanding of the course content. I hope to create an environment that promotes honest communication regarding the expectations of the students as well as the teacher via discussions during the class as well as one-on-one conversations during office hours. Lastly, I aim to inspire many students, especially those from historically underrepresented communities, to pursue a career in computer science through my teaching.

Teaching Experience

Guest Lecturer for CIS 673, University of Pennsylvania (~20 students). I gave a lecture on verifying the robustness of neural networks. The goal of the lecture was to introduce students to applications of techniques that were previously covered in the course to neural network verification. I designed the lecture following my general teaching philosophy of rediscovery. The students were engaged and the class turned out to be quite interactive.

I combined material from three different research papers which was challenging due to different problem formulations and notations. I unified them under one framework and used consistent notation throughout the lecture. I used a constant running example and explained how the three different approaches would be used to solve the example problem. This enabled students to easily compare and contrast the different methods.

TA for CIS 262, University of Pennsylvania (~150 students). I was one of the 8 TAs for the undergraduate course on Automata, Computability, and Complexity. For many students, this course is an introduction to the formal mathematical treatment of various fundamental concepts in computer science. Many students lacked the mathematical maturity to understand complex logical reasoning and found writing mathematical proofs challenging. During my office hours, I spent time with such students and gave plenty of examples to illustrate how mathematically rigorous arguments look. I then tasked them to solve problems related to the class requiring them to write proofs on their own. In order to keep students motivated, I also gave examples of incorrect results from recent papers which could have been avoided had the authors been more thorough with the mathematical details.

TA for CIS 540, University of Pennsylvania (~20 students). I was the only TA for the graduate course on Principles of Embedded Systems. I gave guest lectures and helped with creating assignments and designing projects. Being the only TA I made sure that I was always available and responded promptly to questions on Piazza.

AAAI Tutorial. I am co-presenting a tutorial at AAAI 2023 on recent advancements in reinforcement learning algorithms for learning policies from temporal specifications. This is a quarter-day (1 hour 45 minutes) tutorial in which we aim to introduce the audience to this maturing research area while providing key results from existing work and potential directions for future research. This tutorial will present the literature in a unified framework that helps the audience understand the differences among and significance of various works.

Informal Teaching. In general, I have been fond of teaching seemingly hard concepts to my peers. For example, when I took CIS 511, a graduate course on Theory of Computation at the University of Pennsylvania, there were times when I knew the main concepts beforehand (from undergraduate courses I had taken) and was able to follow the classes with relative ease. Later, I was able to teach these concepts in my own style to my peers who were unable to follow certain parts during the lectures. I have received feedback from my fellow Ph.D. students that my teaching helped them achieve a solid understanding of many seemingly hard concepts.

Teaching Interests

I am looking forward to teaching courses in the areas of Formal Methods, Machine Learning, Programming Languages, and Theory. In particular, at the undergraduate level, I am interested in teaching courses on topics such as Algorithms, Theory of Computation, Machine Learning, Reinforcement Learning, Probability Theory, Discrete Mathematics, and Linear Algebra. At the graduate level, I would like to teach courses related to Formal Methods such as Computer Aided Verification, Program Analysis, and Software Foundations as well as courses related to Machine Learning such as graduate-level Machine Learning, Deep Reinforcement Learning, Measure Theoretic Probability and Theory of Markov Chains and Markov Decision Processes.

If I get the opportunity to design a new course, I would like to teach a course on Logical Reasoning in Reinforcement Learning. My dissertation work adds to this broad area which has seen a lot of progress over recent years. Such a course would cover major themes at the intersection of formal methods and reinforcement learning including reinforcement learning from logical specifications, neurosymbolic approaches to learning interpretable policies, theory and hardness results, and verification of closed-loop systems with neural network components. This course would provide a comprehensive overview of current research and encourage students to pursue research on related topics by introducing them to open problems and challenges in the area.