Teaching Statement

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Teaching Philosophy

Teaching is a central and vitally important part of academic life. In the following, I present my teaching philosophy and then discuss my current and future teaching activities.

My approach to pedagogy is four-fold:

(1) integrate lecture content and critical discussion;
(2) connect theory with applications;
(3) broaden participation and promote inclusivity; and,
(4) bring research into the classroom.

One of the main goals I have as a teacher is to help students develop their critical thinking skills, and in my experience one of the surest ways to instill a deadening torpor in the classroom is to endlessly lecture away without taking the pulse of the room and eliciting discussion, early and often. Engaging with students by encouraging them to speak up, to hear what they think about the subject if only to encourage them to reflect on it, and to challenge them to challenge the material has been invaluable in improving student comprehension of the lecture material. Incidentally, it has also been invaluable in exposing gaps in my own understanding and exposition of lecture material.

Theory and application is one of the classic dividing lines in computer science, and can be one of the hardest to bridge. However, true mastery of the subject in my estimation requires synthesizing understanding of each side to the greatest degree one is able, since one cannot be whole as an independent thinker without expertise in both. In my teaching, I have seen both sides of this coin: on one hand, students that have an amazing ability to apply information, but are unable to generalize or pivot to related concepts due to a lack of theoretical underpinning; on the other hand, I have similarly seen numerous students that have an excellent theoretical understanding of a subject fall flat on their face when faced with connecting that understanding with the real world. I strive to impart both theory and the ability to apply it and achieve tangible goals, and view this as an important metric of my effectiveness as an educator.

Computer science and STEM more broadly has historically skewed towards particular racial, social, and gender groups. Frustratingly, this exclusion becomes increasingly severe across the undergraduate and graduate progression. For instance, it is widely acknowledged that if not careful, it is all too easy to lose students from under-represented groups over time through degree transfers or outright attrition. Thus, it is critical to focus not only on recruitment from traditionally marginalized populations, but to also retain these students throughout their degree program and to successful completion. In my teaching, I strive to ensure that all students have equal access and opportunity to course resources. I ensure that no one is excluded from discussion and participation, and that any uncomfortable or exclusionary situations are prevented whether in classroom settings or elsewhere. Finally, I recognize that as an educator the onus is on myself to reach out to under-represented students, to actively engage with them, and thereby help promote and maintain diversity in the classroom. This viewpoint translates to my role as an advisor, where I have made a concerted and sustained effort to recruit research assistants from under-represented groups. Diversity of background and thought is no less important in research as it is in the classroom.

I view the integration of research—the frontiers of our current understanding—into the classroom as a natural extension of my own research activities. While this naturally occurs to a larger degree in graduate courses, even in introductory courses there is ample opportunity and value in foreshadowing where the material is going, if only to help frame the students' thinking and mental model of a topic. This endeavor requires a significant time investment to continually update course material, an investment that I am glad to pay.

Finally, on a security-specific note, I am of the firm belief that training secure developers and effective security practitioners requires imparting the attacker's mindset. That is, one of the most effective tools I have found to teach students how to defend a system, network, or application is to learn to view it as an attacker would, to find weak points in the design, the imperfect seams between components, and the myriad ways in which untrusted data can flow into a system. Without this crucial ability to don the black hat and learn how to attack systems, one cannot hope to anticipate how others would do the same to your own. Without such understanding, real-world attackers will always have the upper hand.

Teaching Activities

Since joining Northeastern University in 2011, I have taught the combined undergraduate and graduate Network Security course many times. In this process, I reworked the entire curriculum, and greatly expanded upon the labs and assignments to cover a wide variety of contemporary and emerging network security topics. I have also conducted several research seminars where the focus was on leading discussions on research papers drawn from specific area such as control-flow integrity and embedded systems.

I made a significant effort to create an undergraduate introduction to security. This was particularly challenging, as a requirement for this new course was to be scheduled as early as possible in the undergraduate sequence. Of course, by its nature security has many dependencies, and so the main challenge was to carve out the essential principles underlying security in such a way that they could be elucidated in the context of prerequisites the students could be expected to have been exposed to.

In addition to teaching in the classroom, I have also invested a significant effort in expanding participation in Capture-the-Flag (CTF) security competitions, both at Northeastern and elsewhere in the region. In recent years, this effort has expanded to mentorship and engagement as an organizing member of DEF CON CTF, the premier organized hacking competition in the world. CTF competitions are extremely effective tools for building security intuition and practical skills, and I plan to continue building building presence in the global CTF ecosystem in the future.

I have also expended considerable effort in mentoring and advising students at the undergraduate, masters, and Ph.D. levels. In particular, I have conducted numerous independent study seminars, have successfully advised several masters theses, and am well on the way to graduating my own Ph.D. students.

I plan to continue to build on my existing teaching philosophy, to identify areas where I can improve, to develop new material and, hopefully, courses, and—finally—to continue to mentor students in security both within and outside the classroom.

Advising and Mentoring

I currently advise four Ph.D. students, working on topics ranging from malware detection, software testing, and software hardening. Over my career, I have graduated nine Ph.D. students who have gone on to a variety of academic, industry, and government roles at West Point, Microsoft, Google, Block, NYU, Florida International University, Ege University, Akamai, and MIT Lincoln Laboratory.

I have also mentored a number of research scientists and postdocs, who have gone on to positions at Amazon Web Services, Montclair University, the University of Vermont, INRIA, and Cruise.

I have mentored numerous M.S. students who have either completed a final project or a thesis. Many of these students went on to serve in various capacities within DoD.

I am a strong supporter of broadening participation in computing. The Ph.D. students I have graduated are drawn from a diverse set of cultural backgrounds, and includes one woman. Of my current Ph.D. students, two are women and two are non-binary. I plan to continue recruiting with diversity in mind, to help computing progress towards a future that reflects the diversity of the society it serves.