Teaching Statement

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‘Computer Networks’ is often taught, unfortunately, as a History class. — Scott Shenker

Too often, a networking class is merely a collection of network protocols; the design rationale largely an afterthought, and the possibility of rethinking for this brave new world nearly absent. I believe we must drive students towards good design. This applies not just to networking, but more broadly to computer systems, and even algorithms. I believe this to be a more holistic approach with the potential to create not only graduates well acquainted with today’s methods, but also capable of advancing them. Below, I elaborate on some of the methods I incorporate in my teaching to fulfill these objectives.

- **Rediscovering concepts:** Often, instead of simply reading a research paper, I pick on the problem being addressed, and attempt to build my own solution independent from the paper. This approach allows a better internalization of the problem, the deficiencies of naive solutions, and a better informed critique of the work at hand. I think of this approach as invaluable for teaching as well. The teaching of algorithms, for instance, benefits from first attempting the brute force solution and analyzing its complexity; even failures in the process of coming up with a smarter algorithm help in understanding the problem better. Likewise, in my teaching, I attempt to rediscover with my students the concepts being taught.

- **Challenging the assumptions:** It is important to train students to identify and scrutinize the implicit and explicit assumptions behind canonical concepts. Past work that exposed such assumptions is instructive — in networking, assumptions of Internet route symmetry and triangle inequality in Internet latencies are good examples. Conversely, following where imaginative assumptions lead also stimulates innovative thinking. For instance, what if we had a ubiquitous speed of light Internet? Such scenarios help students sidestep a common stumbling block — “All the innovation is done.”

- **Conveying the excitement:** Networking is often thought of as a ‘nuts and bolts’ discipline, devoid of flashy demonstrations and cool robots. True as that may be, networking, and more broadly, computer systems research, has produced incredible, tangible advances in our lives. The Internet is an obvious example, but networks are also central to science and technology in less visible ways — whether it be extreme engineering feats of networking deep ocean sensors for the Ocean Observatories Initiative, and the Square Kilometre (Telescope) Array, which will generate cosmological data at a rate comparable to the total traffic on the Internet; or building supercomputers that help study genetics, cancer, climate, high energy physics, etc.

- **Collaborative and competitive work:** While I have not yet tested this approach, I plan to make class projects collaborative as well as competitive. For instance, project groups could compete to move the maximum amount of traffic across a toy network. Such an exercise would draw out the intricacies in the design of flow algorithms, multi-path routing and congestion control. Hopefully, competition will spur greater interest in the projects and lead to better learning outcomes.

So far, I have assisted in teaching a beginner-level programming course, as well as a senior-level algorithms course. Over both courses, I enjoyed engaging with students, having them reason through why certain methods and algorithms work, and guiding their use of a principled approach in coming up with solutions to problems. I have also mentored undergraduate researchers, with one of whom we have released a Chrome browser extension which lets users measure their true web-browsing experience and compare ISPs in their area, while also gathering data for our research on Internet latency.

Soon, I will also be teaching a massive open online course (MOOC), UIUC-Coursera have announced a series of courses on ‘Cloud Computing’, and UIUC is having me lead the course on ‘Cloud Networking’ (with co-instructor Brighten Godfrey). The other courses are being taught by UIUC faculty members Indranil Gupta and Roy Campbell. An enrollment of tens of thousands of students per year is expected. I am currently developing the curriculum and materials for this course, including a project that involves students experimenting with cloud infrastructure. As I am learning, preparing a MOOC is very different from a traditional class. The largely one-way format (given the impossibility of interacting with even a tiny percentage of students) mandates an extraordinarily careful approach to the design of assignments and grading. In addition to collaborating with the instructors teaching the other courses to ensure the effectiveness of our course series, I also find myself working with videographers and designers! For more information on this upcoming course, see: [https://www.coursera.org/course/cloudnetworking](https://www.coursera.org/course/cloudnetworking). MOOCs are a recent innovation in education, and I am looking forward to seeing how the experiment unfolds.

I believe these experiences, together with my own education and research, have prepared me to teach networking, systems, and data structures and algorithms at the undergraduate level, and networking and network security at the graduate level. I will also explore with colleagues the development of advanced cross-disciplinary courses related to big data applications, both in physical and virtual classrooms. I am excited to be able to develop courses, and teach and advise students.