Teaching Interests

Traditional barriers in scientific education are quickly breaking down, and an increasing emphasis is being placed on a holistic approach to university learning. The modern engineering student needs to acquire a diverse array of skills in order to effectively compete and excel in a professional career. For electrical and computer engineers, these include core technical skills in related fields such as computer science, discrete and continuous optimization, functional analysis, and statistics. These also include more general soft skills such as the ability to work in a large team, the ability to realize conceptual ideas into tangible prototypes and/or software, and the development of effective skills in technical writing and communication for a wider audience.

The core elements of my teaching philosophy mirror the basic principles of my research agenda: an attention to a breadth of technical topics, and an emphasis on inter-disciplinary skills. I am capable of teaching a variety of undergraduate courses including signals and systems, introduction to algorithms, probability theory, and numerical analysis; graduate level courses on information theory, advanced algorithms, statistical signal processing, and machine learning; and seminar-style courses on topics such as compressive sensing and sparse approximation, high-dimensional geometry, and optimization. I will also incorporate several aspects of soft skill development into my teaching process, detailed as follows.

Working in teams. I believe that team exercises enable learning at an accelerated rate, and simultaneously help students acquire and develop effective skills for technical communication. In Spring 2014 at MIT, I co-instructed a large undergraduate-level course on “Mathematics for Computer Science” (Course 6.042), covering the basics of probability, graph theory, data structures, and discrete algorithms. The class is designed to cover essential topics in mathematics that are necessary knowledge for Computer Science majors, but that are not typically included in a standard algebra or calculus curriculum.

The course followed a flipped-class structure: students prepared by watching video lectures on the material that are pre-available online, and the class itself entirely consisted of solving problem sets in small teams. In my experience, the teamwork aspect of the class enabled a unique sense of synergy among the students, and made learning both productive and enjoyable. I anticipate that such a flipped-class model will rapidly become prevalent in several types of curricula, combining modern elements of educational technology (such as video lectures with online feedback) with traditional ideas (such as recitation classes).

Learning by doing. I subscribe to a hands-on approach to learning. I believe that the best way to enrich class material is by including assignments and projects that involve a creative application of the concepts learned in class. In Spring 2015 at MIT, I will co-instruct a large undergraduate-level course on “Introduction to Algorithms” (Course 6.006), covering algorithmic paradigms and data structures used to solve basic computational problems. Together with conventional lectures and
weekly written assignments to establish basic concepts, this course will place a particular emphasis on the learning-by-doing approach by supplementing each assignment with coding exercises in Python.

I experienced the considerable benefits of the hands-on approach when I was a Course Assistant for several editions of the undergraduate courses on “Signals and Systems” (ELEC 301) and “Digital Signal Processing” (ELEC 431) at Rice University. Together with the material covering the fundamentals of continuous- and discrete-time signal processing, these courses included a month-long project that involved applying the ideas learned in class to a practical scenario. I advised several teams of students working on various topics included a visual semaphore system; a method for detecting stop signs in traffic videos; and a method for automatic speaker identification. By participating in these projects, the students gained a deeper understanding of the material, and their final work was consistently excellent.

**Technical communication.** A critical aspect of a technical education is the development of effective technical writing and speaking skills. I believe that carefully crafting an expository summary of class lectures both enhances the students’ understanding of the material and sharpens their writing abilities. I have found that an open debate-style discussion among the students on the material encourages the students to internalize the concepts taught in class.

For both graduate-level and seminar courses, I will conduct a weekly review session in which students discuss and debate the lecture material and papers discussed in class. I will also encourage the regular scribing of lectures and seminars by my students. These notes will be drafted by a designated student, and will be critiqued and refined by other students on an internal wiki prior to being posted online on the web.

**Outreach.** Along with conducting high-quality research and imparting a valuable teaching experience to students, I believe that an essential component of service as a university professor involves the timely dissemination of knowledge, ideas, and academic tools to the wider public. This aspect complements the spirit of *reproducible research*, a philosophy that encourages the free distribution of raw data and software used to generate technical results in scientific publications. I have practiced this philosophy in my own work by developing and releasing several software packages for reproducing results from my research papers (http://people.csail.mit.edu/chinmay/resources.html).

I will also emphasize the dissemination of expository material on educational content platforms such as OpenStax CNX (http://www.cnx.org). Formerly known as Connexions, OpenStax CNX is an open-source portal for sharing educational information in the form of small “knowledge modules” with students and researchers across the world. Using material based on my own research, I have co-written several knowledge modules on advanced signal processing topics. Some of these modules have been collated into an e-textbook called “An Introduction to Compressive Sensing”. This textbook has been used in several graduate-level courses in sparse approximation and compressive sensing in universities across the US. In all, this material has been accessed nearly 10,000 times.