Statement of Teaching Interests
Sumit Basu

sbasu@media.mit.edu
Ph.D. candidate in MIT EECS;
MIT Media Laboratory

I have had a good number of teaching opportunities in the last few years – from casual situations where I was helping out a fellow graduate student to teaching at a quiz review in front of 300 undergraduate and graduate students. In between, there has been the mentoring of an intern at MSR, teaching of undergraduate research assistants, presenting papers at reading groups, co-teaching a songwriting workshop for high schoolers, and much more. I've learned something different from each of these situations, and hope I can use this knowledge in the next phase of my academic career. I feel I'm qualified to teach courses in any of the areas I work in: signal processing, multimodal signal processing, speech processing, probability, machine learning, computer audition, computer vision, etc. Instead of merely providing a list of courses, though, I'd like to use this space to give a background of my teaching experiences and describe some of my ideas for new courses. I hope that this will give a more complete picture of my teaching potential.

The teaching experience I have learned the most from is without a doubt my Teaching Assistantship (TA) for Probabilistic Systems and Analysis at MIT, a joint undergraduate/graduate Electrical Engineering course that is a core requirement for undergraduates. Unlike most TA positions, which only require grading and holding office hours, this involved teaching a weekly one-hour recitation to a group of about 40 students, running six problem-solving tutorials (5-8 students each) a week, and doing occasional quiz reviews (together with other TAs) for the 300 person class. We sketched out the plan for each week's recitation and tutorials together at a weekly meeting, but it was up to us to decide how to best present the material. Though extremely time-consuming, this was one of the most exciting jobs I've had in my life. Much to my surprise, a group of 40 undergrads can be tougher than an oral exam committee: the students often have no idea what the answer is or even how to phrase their confusion. As a result, there’s no one to give you a gentle hint when you’re stumbling – it’s up to you to find out what they really want to know and guide them towards understanding. Other times, the right answer is simply admitting, "I don't know, but I'll find out and get back to you" – perhaps the hardest answer of all to give. What makes it all worthwhile, though, and a lot more enjoyable than an oral exam, is that the class wants to learn something from you, especially if you can do something to motivate them. They look to you as a guide through unknown waters: they're willing to paddle if you'll only point the way. I made many mistakes when we were starting out, but I think by the end of the term I had learned to stop grabbing the oars and became more effective at doing the pointing.

The world of one-on-one sessions with students was a similarly educational experience, but quite different in what it had to teach me. The main thing I learned and relearned was that it is simply not sufficient for a teacher to know something in only one way. Though you may believe you have the cleverest possible mental representation for the law of iterated expectations, it may be quite meaningless to the student you're helping. In the recitation room, I could present material in the way I thought best and see that most of the class was nodding along, but it was during the one-on-one tutorial and office hour sessions that I really saw what had worked and what hadn't. Being able to adapt one's representation, to attack the same problem from many different angles, was an important skill I learned through this experience. It’s something I've since applied to my research collaborations as well.

Overall, I had a wonderful experience with the class, and I'm very proud to know the students felt much the same way. The MIT EECS "Underground Guide," compiled from students' comments, had the following to say about me: "Recitation instructor S. Basu was extremely well-liked by his students, receiving comments such as "Sumit rocks the house!" from his students. He was very available, very friendly, and very helpful, taking the time to help his students whenever it was needed. He was considered an excellent teacher, who was always prepared and had good examples to clarify his points. His tutorials were ‘great fun’ and very helpful for learning. His explanations were clear, and very helpful."
Another experience that has shaped my teaching interests has been here at MSR, where I had the good fortune to be a mentor for an intern, Ian Simon. Ian is a brilliant young researcher at the University of Washington, and we are still collaborating on the musical style analysis/synthesis project we began this summer. This is the first opportunity I’ve had to advise a graduate student, and the experience was both more rewarding and challenging than I had expected. Ian is very smart, and with his intelligence came a healthy dose of skepticism. Early on, when we talked about algorithms and approaches to problems, he would often doubt my intuitions and suggestions. As time went on and I was able to demonstrate my experience with examples and particular solutions, I began to win his trust. Within a few weeks, we had a great working relationship, and though we will still argue about algorithms, I am surprised and touched at the respect he gives to my suggestions. At the same time, I have been consistently impressed with the level of commitment and creativity he brings to the problem. I’ve worked with many very sharp undergraduates before, but I found Ian can leap through layers of concepts in a way I had not expected. As a result, we’ve made great progress on our project, and I feel I’ve learned something significant about how to work with bright new researchers.

Looking over my teaching history, I have found both in teaching large courses and in working with interns and undergraduates that the best motivation for learning about theory is an interesting application domain. In lecture, I saw that when the professor tied probability theory to games and stories, the students’ retention was significantly higher than when he simply presented a new chunk of theory. Similarly, when my undergraduates or interns would implement a learning algorithm for some task, we would learn far more about the underlying theory. There are two forces at play here – the motivation to learn from an interesting domain, and also the process of learning by doing. As a professor, I would like to integrate both of these aspects into new courses. A particular example I have in mind is a course that would teach signal and speech processing through the vehicle of sound effects, drawing on both my academic and musical backgrounds. Instead of learning about filters, feature extraction algorithms, etc., in an atmosphere devoid of context, the students would implement these algorithms and/or use them for sound processing in a real-time environment. Every engineering undergrad knows what a single pole filter looks like, but how many know what it sounds like, and what the parameters do to the sound? What if you could manipulate the shape of the filter and listen to the resulting sound? There are so many questions like this I asked myself as undergrad, and which many music, arts, and even signal processing friends have asked me about in grad school. How can you speed up speech without altering its pitch and what problems does it create? How can you reproduce the effects you hear on rock guitars and electronica tracks? How can you lock your off-key singing onto pitch and make yourself sound like a star? I think these are questions that would inspire any student who has an interest in music. At the same time, answering these questions would give me the opportunity to explain the core theories of signal and speech processing.

I have similar ideas for courses in machine learning and probability. In many cases, this may be a matter of adding special lab components to courses instead of completely reinventing them. Of course, there is the caveat that this is more important for undergraduate courses, since graduate students typically have their own applications in mind and are thus already motivated. In any case, implementing these ideas would take a significant effort on my part – the labs would be just another burden to the students if there weren’t a smoothly integrated set of tools to explore them with. In the end, though, I think the effort would be worth it if it could inspire deeper learning. I am a strong believer in theory, but I know from experience that without context it goes in one semester and comes out the other. I firmly believe that we better learn from those experiences in which we actually build things, that learning is all about the delight of discovery. I see it as my duty as a teacher to inspire and foster that delight, and hope to apply this philosophy liberally in my teaching career.