Teaching Statement

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1 Introduction

Teaching is an integral aspect of being part of a university and is a key reason for why I want to be an academic. Enthusiastic teachers and mentors have been instrumental to my success and I hope to be able to have a similar influence on others.

I have a wide variety of teaching experiences, for which I have received multiple awards. This includes being a teaching assistant for university courses – both at the undergraduate and graduate level – which involved everything from classroom teaching and online interaction to handling course logistics and setting and evaluating exams and homework exercises. However, I have also been involved in less structured teaching, including being a research advisor to undergraduate summer students, advising undergraduates selecting courses and their major, and providing extra-curricular mentoring for high school students learning advanced computer programming.

My teaching experiences have been thoroughly enjoyable and rewarding and have also been learning experiences for me. Teaching requires a deep understanding of the material and also requires understanding how students think about it – and how they can get confused. Above all, I enjoy interacting with bright students and imbuing them with an appreciation for computer science.

Going forward, I am eager to be able to teach and develop courses and also to be involved in research advising. I am keen to teach a variety fo computer science courses, such as (randomized) algorithms, cryptography, complexity theory, coding and information theory, and learning theory. I would particularly like to develop a course on rigorous approaches to data privacy (which forms part of my research). Such a course would touch on a broad swathe of computer science – algorithms, probability, proofs, information theory, cryptography, and learning theory – and would invite students to consider important philosophical questions about the role of technology in society. This could also form part of a broader course, such as cryptography.

Advising research students is a privilege that I look forward to having. The goal of research advising is to help students become independent researchers. This requires balancing the need to be "hands off" and let students find their own path with the need to be "hands on" and help students navigate the many obstacles to conducting successful research. Finding the right balance depends on the student, as well as the stage they are at.

2 Teaching Experience

Over the past decade I have been involved in a number of teaching activities, which are listed below. Overall these experiences have helped me appreciate the importance of teaching and hone my skills.

Head Teaching Fellow for *Introduction to the Theory of Computation.* In the Fall semester (August–December) of 2012, I was the head teaching fellow for CS121 at Harvard University, taught by my advisor, Prof. Salil Vadhan. The course covered introductory automata theory, Turing machines, and NP-completeness. This was a large course with over 120 students and a total of 9 staff. The course was required for computer science and most of the students were sophomores.

This course was my most demanding teaching experience. My responsibilities included, teaching a weekly one-hour "section" (i.e., going over example problems on the board with a group of a dozen students), holding two weekly office hours for answering student questions, answering hundreds of student questions online, and writing, grading, and providing solutions to exams and weekly

problem sets. Also, as the head teaching fellow, I was responsible for many logistical tasks, including scheduling, maintaining the website, and storing and distributing student grades. In addition, I also gave one of the lectures when the professor was away.

This experience exposed me to almost the full spectrum of teaching responsibilities and I learned a lot from it. The students had a wide range of backgrounds and, for many of them, it was their first (and only) exposure to rigorous mathematical arguments. As such, I felt it was important to not just teach the students the technical material, but also to give them an appreciation for why the material was interesting. I want to encourage students to take further theoretical computer science courses. However, for those who do not continue studying theoretical computer science, I want to leave them with a "take-away message" that theory provides a valuable perspective on computing.

In the anonymous evaluation at the end of the course, one student wrote that "Thomas literally kept me from failing this class. Without him, I'm certain I would have failed by now. His lectures and sections were amazing. I understood everything I didn't understand in lecture clearly and quickly by his doing." Based on the student feedback, I was awarded a Certificate of Distinction for Teaching by the university.

Teaching Fellow for *Algorithms for Big Data.* In the Fall semester of 2013, I was the teaching fellow for CS229r at Harvard, taught by Prof. Jelani Nelson. This was a new graduate-level research seminar with 20 students (a mix of undergraduate students, graduate students, and cross-registered students from MIT) that covered recent research in streaming algorithms and sketching. I also had the opportunity to give one of the lecturers while the professor was absent.

This course was a very interesting experience, as much of the material was also new to me and it was the professor's first time running a course. So I saw how a new course is developed.

Teaching Fellow for *Pseudorandomness.* In the Spring semester (January–May) of 2015, I was the teaching fellow for CS225 at Harvard, taught by Prof. Salil Vadhan. This was a graduate-level course with 12 students (the majority being undergraduates) that covered pseudorandom generators, coding theory, expander graphs, extractors, and derandomization – topics which are close to my research interests.

I greatly enjoyed the interactive nature of this small class. Rather than lectures, the class was driven by comments that students submitted in advance on the reading material or in class. This allowed the discussion to focus on points that were either unclear or were not covered in the reading material. Being interactive is essential for engaging students. And it is important to spend time to understand what is confusing to students and then tailor the presentation to their needs.

I was again awarded a Certificate of Distinction for Teaching based on student evaluations. Later, I was also nominated by the department for the Derek C. Bok Award for Excellence in Graduate Student Teaching of Undergraduates.

Mentor for Summer Research Students. In 2014, I co-mentored an undergraduate summer research student who worked on a project in pseudorandomness. His project resulted in producing an improved pseudorandom generator for the class of read-once boolean formulae.

In 2015, I co-mentored two summer interns who were part of the *Privacy Tools for Sharing Research Data* project at Harvard. This large NSF-funded project brought in a dozen undergraduate interns each summer who spent 10 weeks working on implementing and evaluating algorithms and tools that would form part of a system for private data analysis.

These experiences were eye-opening in many ways. In particular, I had to help identify research projects for the students to work on and, when they got stuck, I had to help them without taking over their project – both tasks require finesse. I had to learn to balance the need to let students explore on their own versus guiding them towards what I thought was the right approach, which was particularly critical as there was a limited timeframe to complete the projects over the summer.

Non-Resident Tutor in Lowell House. From 2013 to 2016 I served as a tutor in one of the undergraduate houses at Harvard. This involved everything from social activities to academic advising. In particular, I was assigned as the primary academic advisor to several undergraduate students and I was responsible for helping them select courses and eventually select their major.

It is important that teaching does not end when students leave the classroom. Being involved in Lowell helped me appreciate the the community environment that the university provides.

Involvement in the New Zealand Olympiad in Informatics (NZOI) Training Program. I have been involved in programming contests, first as a contestant and then as a teacher. For several years, I was an instructor at the annual NZOI summer training camp. This week-long camp brings high school students from around the country together to learn programming and algorithms. Four of the participants are then selected to represent New Zealand at the International Olympiad in Informatics. At the camp, I gave lectures, set problems, and provided one-on-one assistance to students. I also served as a mentor after the training camp for some of the selected students.

I found working with these bright high school students extremely rewarding. I could see that many of them, in the course of learning about and then implementing algorithms, were experiencing the same wonder that attracted me to computer science. To me, this is the essence of teaching – a teacher should transfer their enthusiasm to the student.

The NZOI camp is also a fantastic outreach program that helps recruit undergraduate computer science students. I strongly support efforts to expose more high school students to computer science.

Mathematics Tutor. As an undergraduate student, I also was a tutor for several mathematics courses at the University of Canterbury. This involved running weekly problem sessions and grading homework assignments. I was a tutor for a total of six courses covering calculus, linear algebra, and real analysis at the first- and second-year undergraduate level.

3 Future Plans

I look forward to having further opportunities to be involved in teaching and mentoring at all levels – from outreach in high schools and introductory undergraduate courses to advanced research-level courses and advising graduate students.

I am keen to be involved in teaching theoretical computer science subjects, such as computational complexity theory, coding and information theory, (randomized) algorithms, learning theory, and cryptography. I believe that I can bring my own perspective to these areas and I am enthusiastic about getting students to appreciate the power of rigorous mathematical thinking, even if they are not intending to pursue theoretical computer science further.

I would be particularly interested in developing a course on the mathematics of data privacy, which ties in to my research on differential privacy. This topic offers a self-contained and cohesive subject material that also naturally connects with other areas of computer science (such as cryptography, learning theory, and information theory) as well as statistics and law. Similar courses are currently taught at half a dozen universities worldwide. I would also like to incorporate my research on generalization and adaptive data analysis into a course on machine learning.

I am especially eager to recruit and work with PhD students. Advising junior colleagues provides the greatest opportunity to impact the lives of others through teaching. It is also an enormous responsibility and privilege. From my own experience as a student, I have seen the importance of having a strong, collaborative relationship between a student and their advisor.

A research advisor should be dedicated to providing the best possible opportunities to their students – the student's success is the advisor's success. This requires both guiding the students when they lack direction and also letting them grow their own independent research agenda and appropriately balancing these competing goals. I look forward to taking on this challenge and helping students succeed as researchers (or outside of research, as the case may be).