Teaching Statement

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All my life I have enjoyed explaining things to people. I find it to be a stimulating intellectual challenge to find the key of how to explain a concept to benefit the given audience. I have had experience teaching both individuals one-on-one as well as larger groups; ranging from math and CS classes in universities, to coaching high school and college students in math and to facilitate fun math classes for elementary school kids in summer camps. I am passionate about my research, but have found that discovering exciting new theoretical concepts and devising efficient algorithms gives me the most satisfaction if I can share it with other people. I also believe that, given my skills and background, teaching is the best way for me that I can contribute to science. That is the reason that I am seeking a career in teaching at a research university.

Courses to teach. There are a wide variety of courses, both at the undergraduate and graduate level, that I would enjoy teaching. Based on my firm background in mathematics and algorithms I believe I can contribute substantially to teaching theory and mathematics-type courses, such as **linear algebra**, **combinatorics**, **probability**, **algorithms**, or **statistics** at the undergraduate level. At the graduate level I would love to teach **theory of computation**, **advanced algorithms** (approximation, randomized), **graph theory**, **optimization techniques**. My research interests have driven me to more application oriented topics that I would also enjoy teaching. Some of such courses are **data science**, **network science**, **computational tools for data research**, **data mining**, **machine learning** or **information retrieval**. I am looking forward to be teaching other courses as well, as the need arises.

Developing future courses. Through my own research experience as well as interaction with students and other researchers I have found that, besides the extensive knowledge in the area that the research is conducted, it is paramount to have a solid basic of mathematical and computational skills. The same is true for applied computer science, where having these skills as second nature is an unrivalled asset. Therefor, I propose to develop courses targeting to build this toolbox for the audience. Obviously these skills are taught as part of other classes, but they are often just technical parts in the context of some more complex algorithm or procedure. I envision to present these tools as self contained units that become building blocks of the more complex tasks.

At the undergraduate level I think that improving basic skills in combinatorics (e.g., set operations, counting, efficient enumeration, certain data structure concepts), analysis (e.g., the concept of magnitudes of functions, analyzing properties of an objective function), probability and statistics (e.g., seeing the likelihood of events in a whim, perform basic statistical tests, using the concept of expectations) and logic (e.g., using logical deductions as a tool for devising algorithms) would be very useful. I believe that this course would not only benefit future computer experts but also students in other disciplines such as biology and life sciences, sociology and any kind of task requiring massive data research.

At the graduate level I expect the students to already have mastered the above skills. Here it is interesting to have an outlook on developments in other sciences and make use of tools for other fields in our work. Besides learning the given tool at hand, I intend this course to also serve students in exploring how to follow other science disciplines at a high level and filter out what is science specific or what may be useful for our use. Given my background and current interests I am mostly qualified to cover developments in the field of mathematics. I am looking forward to team up with other faculty members with insight into other fields (for example financial field, natural sciences, sociology, engineering etc.) In the form of a course, I think it makes sense for a course that meets two times a week, to have first a lecture by the instructor covering the basics of the target research and then have an expert in the area give the other lecture with the most hot developments. Some possible topics in mathematics are randomized proof techniques (these could be turned into stopping conditions in algorithms), graph theory and network science from a math point of view (e.g., graph limits to study networks of unknown size such as the Internet, random walk based algorithms, etc.), information theory (currently research on description length as a way for picking the best modeling tools is a very promising topic) or statistical tools (e.g., choosing and efficiently using statistical tests).

A version of the graduate level course focusing on current hot topic research would also work well for a weekly departmental seminar that would be geared towards building the research toolbox of PhD students and anybody interested. This seminar would also be a great opportunity to involve PhD students in the organization of the seminar, giving students the responsibility (with faculty guidance) to pick out the topics, prepare and give the introductory lecture on the topic, find and invite the experts on the topic.

Teaching experience. During my academic course I have been a Teaching Assistant for both computer science and mathematics related courses. I have taught a total of **5 courses** in 7 semesters, teaching **12 sections** of sizes ranging from 9 – 25 students. As a total I have had about **200 students**. My duties included **leading discussion sections, preparing problem sets, coordinate graders and hold office hours.** I also had given lectures over the years in various seminars and classes.

At **Brown University** I was asked to cover some of the lectures in a computational biology course titled **Computational Molecular Biology** that is offered by the computer science department. The lectures that I taught presented methods for data compression and querying that can be used for genome sequencing problems, given that in genome data often only partial matches for queries can be obtained. The audience of this class consisted of upper level undergraduate and graduate students. However, there was a wide variance in their background (students from other departments attended too) and knowledge on algorithms among the participants. The feedback that I received was that I was very successful at explaining the algorithmic techniques in such a way that the whole audience could follow not only the steps taken in the algorithms but also the intuition behind the techniques used.

At **Boston University** I had the opportunity to teach introductory as well as advanced courses. In the Summer of 2014 I was a Teaching Assistant for the course **Algorithmic Techniques for Large Problems**. This course, for seniors and graduate students, was a theory course mostly focusing on algorithm types suitable for large data, such as approximation or randomized algorithms. My job was to help develop homework questions, hold office hours and coordinate homework solutions with graders. In Fall 2012 I was a Teaching Assistant for **Analysis of Algorithms**. This is a mandatory course for CS majors and graduate students and is regarded as one of the most difficult courses in our department. My responsibilities were to lead all three discussion sections, hold office hours and coordinate the graders. I had to develop a curriculum that would help my students understand and also turn into applicable knowledge the theory that was covered in the lectures. Students signed up voluntarily to one of the three sections. However, it turned out that the interests and theory background of students were different in the three groups and so I had to adjust the curriculum to each group. I also developed extra problem sets for my students to be able to practice their skills (these are still available on my website). The problem sets were very well received, and students responded that they were great help as they studied for the exams. In Fall 2011 I was a Teaching Assistant for **Arts and Crafts of Quantitative Reasoning**. This is a joint course between the mathematics and CS department for non-CS majors that gives an introduction to what kind of questions are studied in math, statistics and CS. My job was to lead one of the discussion sections and lead all of the lab sections. In Summer 2011 I was a Teaching Assistant for **Introduction to Computer Science** I was responsible for leading the lab sections and grading homework assignments. In the lab the students learned basic concepts of HTML, Flash and Jython. I also delivered the lectures on binary numbers and on data mining.

At **Eötvos University** in Budapest I was an instructor in multiple semesters (between 2007-2009) for the course **Graphs and Algorithms** . This is a mandatory discrete math course - with emphasis on algorithms - for second year math majors. The way students are taught and evaluated in a course in Hungary is different from the American approach; all classes have a distinct theoretical lecture part and a practical discussion part, these two may be facilitated by different instructors. The evaluation is not based on the continuous work of the students during the semester (e.g., there are no mandatory homework assignments to hand in). Rather, for the theory part of the class there is an oral exam at the end of the semester, during which students must recite the theory (including proofs) that was covered in the lectures. For the practical part of the course students write one or two problem-set based exams during the semester and are graded on those. I was the instructor for the practical part of this course. My job included developing the curriculum and problem-sets for the discussion sections based on what is covered during the theoretical lectures, facilitate

the section themselves and devise and conduct the exams and the grading.

Mentoring experience. In 2013-2014 I have been working with a junior (at the time) PhD student, Sanaz Bahargam, on a research project in education optimization. My task in this collaboration was to set the direction of our research and guide Sanaz into the practice of how to do research. Our work resulted in a paper at the conference *Educational Data Mining*. I was very fortunate to learn these skills myself from a more experienced PhD student. I find that these kind of collaborations are very useful for both participants. Besides learning the skills for research or mentoring, this arrangement is also useful because the relationship dynamics between two students are more relaxed than in a professor-student relationship, allowing for more room to ask "silly" questions or express uncertainty. I think that this is a great arrangement and as an adviser I plan to make similar matches among my students.

In Spring 2014 I supervised the class projects for one undergraduate and one masters student, Marcin Swieczkowski and Feiyu Shi, in a class called "Data Analysis for Small and Big Data". It was my responsibility to come up with research questions suitable for a class project and meet with the students regularly to guide them through the projects. The students had to learn about the related work, run experiments, submit a report and finally do a presentation. With Marcin we worked on network engineering for centrality, with Feiyu we investigated load-balancing for centrality. For both students this was their first exposure to doing research and it was very educational for me to take these first steps with them.

Throughout my high school and college years I have been coaching high school and college students in mathematics. I find that this experience was paramount for me both in developing my love for teaching and learning the basic principles that define my teaching approach.