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Teaching Statement

For most of my adult life it has been my goal to become a professional math educator. I believe that this is important work and I find teaching and writing demonstrations to be genuinely enjoyable and enriching, to the point where I spend a large portion of my free time coding interactive demonstrations of mathematical concepts. More importantly, in my experiences as a student, a tutor, a teaching assistant, and a teacher I have seen a lot of problems with the way that math education is typically handled that tends to turn students away from the subject, and I believe that I am in a unique position to help improve things due to my educational background, interests, and skill set.

Teaching Interests Because I place particular importance on the issue of maintaining students that might otherwise end their mathematical careers prematurely, I am primarily interested in teaching introductory undergraduate courses such as calculus, differential equations, and linear algebra. That being said I am generally interested in teaching any undergraduate course, and would be particularly interested in teaching undergraduate or graduate topics related to my research interests in operations research, optimization, graph theory, algorithm design, computational mathematics, and mathematical biology. As will be explained below I also believe that project-focused courses are an important component of math education, and would love to teach or design an undergraduate mathematical modeling or operations research course. I would similarly like the opportunity to help with student organizations or outreach activities to help promote interest in and understanding of mathematics.

Teaching Style Within the classroom it is my goal to create an atmosphere of curiosity and mutual respect. From my years of working as a tutor I have found the method of question-driven discussions to be effective in promoting student engagement. Rather than simply talking for the entire lecture I make a point of breaking things up by asking students questions to advance the topic. Asking the right question can prompt a student to discover something for themself that they had never thought of before, which can help them to internalize the concept much more effectively than if they had simply been told it directly. It can also help the student to build confidence and to realize that they have it within themself to discover great things. When using this approach it is essential to encourage curiosity and to let the students know that it is okay not to know everything on the first try. The important part to emphasize is to approach problems in a systematic way without getting discouraged.

Project Focus Another approach that I find useful for promoting student engagement is placing an emphasis on projects rather than homework and exams. Projects can take a wide variety of forms and scales, ranging from month-long modeling projects to simply phrasing homework questions in a slightly more open-ended way that encourages exploration and a variety of solutions. For many students, the entirety of their exposure to mathematics consists of going through long series' of drills that require them to memorize formulas and perform lengthy calculations by hand. One of the most tragic outcomes of the current math education system is seeing bright students that might otherwise be interested in mathematics be turned away from pursuing it because of how badly their early courses have misrepresented the field as being monotonous and useless. This was exactly what almost happened to me during my own undergraduate studies, but I was fortunate enough to stumble into a mathematical modeling course that changed my perspective. I would like to make sure that my own students do not have to be as lucky as I was, and I believe that giving courses more of a project focus helps to accomplish this in two significant ways:

First, whereas it is easy for students to see homework and exams as being artificial and therefore pointless, projects can be made much more obviously practical. This helps not only to address one of the common causes of math hatred among students, but it also gives students a better understanding of what real mathematicians do. Much of the material taught in early math education would be difficult to use, alone, to solve a practical problem, but it often appears as part of a larger problem, and showing that the larger problem exists lets students know that there is more to learn than just what they have seen so far. Projects also allow students to learn skills that are very important for mathematicians but are often overlooked in coursework, like how to think creatively, how to construct a convincing argument, how to find flaws in an insubstantial argument, how to explain one's work, and how to approach problems systematically, all of which are essential skills no matter what field the student decides to go into.

Second, projects can allow students to avoid the large amount of busywork that can result from homework drills. While drills do have their uses, different students learn material at different rates and so require different amounts of practice. Because of this it is often the case that the top students master the material long before their homework sets end, in which case the remainder of their homework teaches them nothing new and leads to boredom. In contrast, projects can be designed to self-adjust and accommodate a variety of learning speeds. A fast student may be able to find the solution to an open-ended question quickly and with little experimentation while a student in need of more practice may struggle for longer and have to try more things, giving themself more practice in the process. In addition, a fast student may be able to continue thinking about an open-ended problem after they have addressed the initial confines, which can continue to give them new things to explore instead of simply having them repeat the same material over and over again.

Mathematical Technology My use of projects, discussions, lectures, homework, and exams is part of an overall attempt to cater to a variety of learning styles in order to keep the class engaging for all students. Another major part of this is my use of technology. As an undergraduate I began programming visual and interactive demonstrations of various mathematical concepts purely out of my own personal interest. Being able to see the evolution of a cellular automaton, or being able to rotate a complicated three-dimensional surface, or watching solutions to a dynamical system change as parameters are varied all help to understand these subjects at a more fundamental level. Over the years I have created a collection of hundreds of such programs, and will create more for use in class in the years to come. See adam-rumpf.github.io/programs/mathematica for a portfolio of my work.

Personal Enrichment In addition to simply teaching students to master the material listed on the course syllabus, I make it a priority for the students to achieve some level of personal enrichment from the course. Focusing on projects and real-world applications can help in this regard, but it is also helpful to set a small amount of time aside to talk about material that is not necessarily part of the syllabus in order to put the course into context or to show what lies ahead. Discussing a real piece of recent research that involves the course material can help to illustrate how it can appear as a small part of a much larger and more complex problem. These sorts of asides do not take too much time, but they are incredibly valuable for demonstrating that mathematics is not all just crunching numbers and that there is a wide world of interesting things to look forward to in more advanced courses. Not every student will choose to pursue a career in mathematics, but it should be a primary goal of any professional math educator to have their students leave the course with a more complete understanding of the immense breadth and beauty of mathematics.