

TEACHING STATEMENT

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Many recognize the usefulness of mathematics in the modern world, as the “queen and servant of the sciences” and the basis of all technology. Mathematicians also know the joy and wonder of mathematics: the beauty of pattern, the creativity of applying logic, and the satisfaction of figuring things out. Yet to many in the general population, mathematics seems to be a dull, dry subject. Although different people will pursue mathematical knowledge to different degrees based on their needs, I believe that everyone is innately capable of perceiving mathematics as lively rather than lifeless.

Because mathematical knowledge is cumulative, students who fall behind at any point in their mathematical education will find it very difficult to catch up. Having stumbled from the path of comprehension, they no longer understand the concepts or motivations behind what they are trying to learn, and find that the only way to keep up with their work is to memorize rote procedures and formulas. Students who have once made the transition from comprehension to memorization will find it almost impossible ever to get back on the road to understanding. Sucked dry of all its juice, the subject of mathematics becomes a shriveled shadow of its former self, and the resentful students now recoil from it whenever possible. But this is not the worst that can happen. More horrifying is the possibility that some such students will go on to become teachers of mathematics. Like a vampire, teachers whose mathematics is undead will practically guarantee that all students who pass through their hands shall suffer the same fate.

Thus, the teaching of mathematics is always a serious responsibility, especially at the university level where we teach future teachers. I taught two large calculus lecture classes at UC Davis. In one my students were mostly engineering majors, and in the other, “short calculus”, they were mostly pre-medical and pre-veterinary students, along with some business students. I prepared lectures, assigned homework, held office hours, wrote exams, and led the grading of these exams. I strove always to convey understanding in my lectures, rather than mere recipes. One of my most rewarding experiences was when one of my

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students wrote to me about how pleased she and her mother would be that she would finally be getting an A in a math class, because for the first time she actually understood what was going on. My average teaching score in these lectures was between “good” and “very good”. From my students I learned the importance of fully writing out examples beforehand, since correcting errors in real time can be confusing for them.

I was a teaching assistant at UC Berkeley for two years. Besides leading discussion sections, holding office hours, and grading homework and exams, my experience included preparing supplementary written material at a time when the curriculum was in great flux. I feel strongly that the responsibility for communicating mathematics lies primarily with the teacher, and that there is no dichotomy between research and teaching—the necessity for clear thinking, which leads to clear communication, spans a continuous spectrum of audience sizes and backgrounds from one’s own head to a class of hundreds of undergraduates. This attitude helps me patiently answer all questions—something my students have consistently remarked upon.

As a software engineer at Google, I took the opportunity to hire and supervise a student intern in a summer project involving high-dimensional classification and clustering. I found this a very rewarding experience and am looking forward to greater opportunities to interact with students one-on-one or in small groups, helping them to work on projects. By applying mathematics in their own projects, they will realize that mathematics isn’t just something they look up in a book, it’s something they can do themselves.

I also conducted over 80 technical interviews for the position of software engineer at Google. During each 45 minute oral interview (including work on the whiteboard) I assessed the analytical and problem-solving skills of the candidates, giving them judicious hints as needed and feeling out their strengths and weaknesses. From this experience I sharpened skills which are often called upon in teaching situations.

Mathematics is fundamentally about patterns. While the human brain is particularly well-suited to thinking about patterns, many people think much better about patterns in concrete situations than in formal abstractions. Thus, I find that examples from applications—if presented clearly and not confusingly—often help students learn, both by enhancing their cognition and by increasing their motivation. For them, showing how mathematics arises in life brings the life back into mathematics. Furthermore, using examples helps retain a diverse group of students. It is quite legitimate and reasonable for those with more demands on their time to wonder about the usefulness of what they

are learning. I believe my personal interest in applications of mathematics, such as game theory and statistical learning, helps me to supply interesting and fun examples to which students can relate. It has been shown that the brain is particularly well-suited to solving problems framed in a social context, and game theory is a unifying framework for quantitative analysis of behavior.

Keeping the examples in mind also helps the teacher stay grounded in the lowest level of abstraction needed for a given audience. For instance, I once was a teaching assistant in a class where the professor taught multivariable calculus to sophomores using the exterior product on linear differential forms. I remembered the joy of reading the unified presentation of Stokes' theorem in Spivak's *Calculus on Manifolds*. But the students in that class were simply lost. On the other hand, when I was an undergraduate, people often learned Stokes' theorem and its cousins first in freshman physics from Purcell's *Electricity and Magnetism* rather than in sophomore mathematics. Purcell's presentation, with its physical illustrations, was crystal-clear.

Although it is not always possible in a large lecture class, I prefer to lead students to discover the math they are learning themselves. Solving their own problems engages their creative, executive, and judgmental faculties, which leads to better comprehension.