

# TEACHING STATEMENT

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## 1. TEACHING PHILOSOPHY

I believe teaching mathematics is an important part of doing mathematical research. Both preparation for lecture and helping students in problem sections and office hours has helped me organize my ideas much better. Therefore, I think that success in the classroom helps create success in research.

My research focus is mainly geometry, so it is not surprising that in teaching I emphasize the geometric, rather than the purely computational, aspects. My belief is that many computational parts of calculus tend to be lost on the student. The student will forget formulas and methods, but I think he or she will more likely retain the intuitive geometric ideas.

As an example, when talking about integration, I use a method I have learned from my wife who is a chemist. A typical problem for a chemist before availability of well written software was to find the area under a “peak” on the output from an analytical machine. A standard practice was to cut out the peak with scissors and weigh it. As chemists have access to high precision scales, this turns out to be a reliable method for integration. The point is to emphasize the geometric understanding of integration applied to a real world problem. This example gives a concrete, tangible application of the concept itself to a real life situation. The students always appreciate such examples.

My philosophy is to explain a few problems well, rather than to run through as many as possible. After finishing the solution, I will often go over the ideas in the computation, and over how to interpret the problem and its solution. I found the book by Polya [7] very useful in many aspects of my teaching. I believe that if students understand a few selected difficult problems thoroughly, then they are better able to work out other problems on their own. I encourage students to work on their own first and try to struggle through the given problems and only when completely stuck (or when they are finished and want to check their work) go talk to their friends or come to office hours. I have always learned most when I tried problems on my own first, even if it meant struggling with a simple point.

## 2. COMPUTERS AND TEACHING

I believe technology and computers can be useful in teaching, as long as they do not get in the way. If a problem can be worked out quickly on paper, the student usually learns more doing it on paper. Computers can be very useful for visualizing ideas, but they should not completely replace pen and paper. For example, every student should be able to draw simple graphs by hand and he or she will more likely understand what the graphs mean this way. If the students *only* see graphs drawn by a computer, they might not think hard about what the picture means. On the

other hand, computers and calculators can be very useful in giving the students lots of precisely drawn graphs. Requiring everything to be drawn by hand will restrict experimentation. Hence, students should learn the basic skills by hand, and then have access to software for experimentation.

Also, certain complicated algebraic or arithmetic computations are probably better left to be done by computer so that they do not interfere with understanding of the concepts. For example, it is useful for students to learn to do basic integration by hand, but I would not dwell on students learning to quickly solve complicated integrals by hand. They will also not see the benefit, and it will probably not help them understand the concepts any better. Being able to use computer algebra software might seem like an honestly useful skill to the students. They can spend more time in trying to interpret the results of the computation, rather than spending all of the time on the computation itself.

### 3. TEACHING EXPERIENCE

My students have included elementary school teachers, precalculus students, science and engineering undergraduates, mathematics undergraduates and mathematics graduate students. I have had the opportunity to teach and help students across the spectrum in many different settings. At UIUC, I have taught advanced calculus, a course in which geometric intuition is key. I have thought the precalculus finite mathematics and basic linear algebra, where visualization of ideas can also be very helpful to students. I have thought a course on elementary differential equations for which I have developed a textbook [5]. The software package IODE [1] is an integral part of this course. Students are encouraged to experiment and to get visual feedback on the material, while learning basics of Matlab or Octave. Currently I am teaching basic real analysis, for which I have also written a textbook [6].

At SDSU I have thought math for elementary school teachers. I have also led problem sessions at UCSD in calculus and undergraduate real analysis. I have graded and ran problem sessions for the graduate real and complex analysis classes, and I ran the qualification examination preparation sessions for real analysis. I have given several seminar talks to graduate students and faculty, at UCSD and UIUC, and other universities, and I have given several presentations at mathematical meetings. I have had a versatile training as a teacher.

I was a free software programmer on GNOME [2], a major free software project. I maintain a free software mathematical package Genius [4], which is aimed at basic research as well as experimentation and education. I have used this software in class when visualization was necessary. I have written over a dozen programming tutorials published by trade magazines and on the IBM developerWorks [3] website. I have also given several long tutorial talks on programming at Linux conferences.

### REFERENCES

- [1] P. Brinkmann, R. Jerrard, R. Laugesen, *Iode — University of Illinois ODE Package*, <http://www.math.uiuc.edu/iode/>.
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- [3] *IBM developerWorks*, <http://www.ibm.com/developerworks/>.
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- [5] J. Lebl, *Notes on Diffy Qs: Differential Equations for Engineers*, <http://www.jirka.org/diffyqs/>.
- [6] J. Lebl, *Basic Analysis: Introduction to Real Analysis*, <http://www.jirka.org/ra/>.
- [7] G. Polya, *How to solve it*, Princeton University Press, Princeton, NJ, 1957.