# TEACHING STATEMENT

ALEXANDER WOO

While a graduate student at UC–Berkeley, I have served as a teaching assistant for undergraduate courses for 6 semesters, leading sections at various times for first semester calculus, linear algebra, multivariable calculus, and an introductory computer science course. In addition, I also had the benefit of learning from excellent teachers while an undergraduate at Williams College. From these experiences I have learned a few useful ideas and techniques. In particular I have noticed a few common but infrequently addressed sources of confusion for students, and developed some strategies for increasing student participation.

One frequent source of confusion is a failure to grasp what kind of object a symbol stands for. For example, in first semester calculus, many students are not always able to tell from context whether a symbol or group of symbols stands for a function, a possibly unknown constant, or an indeterminate variable; some weak students may even go through an entire semester without grasping the concept that differentiation is something one does to real-valued functions, rather than to numbers or to some arbitrary string of symbols. This problem can sometimes be minimized by being extremely careful with notation, for example by reserving certain letters or certain alphabets to stand for certain types of objects. Another generally useful technique is to ask students to try to explain what the symbols stand for in their own words; this helps both the instructor and the students discover the source of confusion.

Another common source of puzzlement for students stems from the use of abstraction, especially when they see it for the first time in linear algebra or a first upper division course. First many fail to understand that they are being asked to do no more than learn new vocabulary; secondly they do not see why this new vocabulary might be useful. Historically, abstractions have usually been created when mathematicians see similarities between several examples so that an abstraction allows them to study all the examples simultaneously, and so that techniques used to solve problems in one example can be extended to solve problems involving the other examples. In teaching linear algebra I have found it helpful to at least some students for me to show them other examples of vector spaces, and how to calculate and solve equations in them, before they are exposed to the abstract definitions. I have also found it helpful to present, as part of a definition, a way to check if some object satisfies the definition.

As for getting students to participate, one method is to regularly set aside some time when students are expected to effectively run the class by asking questions. Frequently, this is simply an hour set aside a few days before an exam for review, or ten minutes immediately before a quiz. Even more time set regularly aside for this purpose is helpful, although it may not be available unless one wishes to require students to pick up a significant portion of the material purely by reading the text. I have found that most students will willingly participate, and even come prepared with questions, if it is made clear that this is expected of them. One of course also answers questions in office hours, but students often learn from questions by other students and answers to them because other students may be approaching the material from a point of view they had not considered.

An extension of this idea is to genuinely wait for questions at natural stopping points in presenting material. Frequently students need 30 seconds or a minute just to figure out they actually need further clarification about what just happened, and, especially on important or difficult points, it can help to accept a minute of silence to ensure students really have no questions. Even for students who understand the material, the minute of silence is frequently helpful because they can use the time to briefly review, while it is still fresh in their minds, what has happened in the previous ten minutes or half hour.

When time permits, it also helps to work out examples and exercises with the entire class. I have learned to go over even the easier portions of an exercise; students appreciate seeing problems done from start to finish, and the easier portions give a chance for me to ask the stronger students to sit quietly for a minute or two and allow the weaker students to participate in a useful way. Doing problems at the board often also allows me to make some general points about writing solutions clearly and effectively. Another related option is to split the class into groups to work on problems seperately. This is, however, even more time consuming, and I personally sometimes have trouble keeping track of several groups at once, although it can be productive with challenging problems and well balanced groups.

I consider teaching to be an important part of my future professional life. I hope to continue to improve as a teacher by teaching and reflecting on my teaching experiences, and through discussions with colleagues, and, most importantly, feedback from my students. I look forward to helping students learn mathematics, and more generally, think and express themselves clearly and effectively, for many years to come.