TEACHING STATEMENT

FORTE SHINKO

In my time both as an undergraduate student at the University of Waterloo, and as a graduate student at both McGill University and Caltech, I have had many opportunities to mentor students in many different classes, including calculus, linear algebra, probability, logic, computability theory, and functional programming.

1. General teaching philosophy

My general philosophy for teaching is to communicate with students in a way that is relatable to the perspective they have on the course themselves. Students come from a wide variety of educational backgrounds, so if an explanation is going over their head, then it is necessary to slow down and explain things in simpler terms. Depending on the course, the students can also have a varying level of interest, especially if it is a requirement for their degree. If a student doesn't express too much interest in a topic, I will try to be more pragmatic in my approach to solving problems. In my experience, many classes are taught in a way that only those who are interested in the topic will do well, and this makes the other students fall behind. It is not realistic to expect every student to be interested in a required entry-level course, and I feel that it is my duty to make the learning experience as painless as possible for everyone involved, and not just for the students who are keen on the topic.

2. Lectures

2.1. **Use of examples.** My teaching methodology emphasizes a heavy use of examples. Of course, every course is taught using examples, but they are often just mentioned in passing, and the students do not often realize that to understand a new proof, they should be working through it in a specific instance to get a feel for what's going on. I often have students tell me that they understand a certain concept, but when presented with an actual example, they struggle to connect it with the abstract version that they have remembered. For this reason, I often go through proofs in a specific setting instead of the general one, since it is much easier to digest, and it sticks much better. Of course, there is always the danger of choosing an example which is not representative of the general situation, so it is important to carefully craft the example to be generic enough such that one can recover the general case.

2.2. **Logistical aspects of teaching.** Something which I feel is overlooked in teaching is planning the logistical features of a lecture which are not part of the material. For example, something which I find important is to write words on the chalkboard with a fairly uniform size, large enough for the back of the classroom to be able to see clearly. Something else which I find important is the use of color. I find that it is especially important in diagrams and drawings, where it can be hard to differentiate all the different pieces if they are in the same color. Another thing which I try to

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remember while teaching is to not speak too quickly, since everyone is trying to digest the material for the first time.

During the COVID-19 pandemic, I had to give many recitations online, which introduced a new set of challenges, most notably, the size of the screen compared to the blackboard. Something I've learned is that I have to plan the material out much more carefully, since moving contents off the screen at the wrong time can confuse students who still need to reference them. Although there is much more space on the chalkboard in the classroom, I believe that this has still proved useful for in-person teaching as well, and in the future I intend to plan out my use of space more carefully.

3. Homework problems

It is not an easy task to help a student with a homework problem without accidentally giving away the solution. There are a couple of common reasons I have found for students not being able to solve homework problems.

The most obvious problem is simply that the student does not understand the material required to solve the problem. In this case, I will ask them much more basic questions than theirs, and if necessary, we will go back to the definition to see if they can internalize the concept. Given an unlimited amount of time, this is the best solution, but this is not always practical, since students have other commitments which limit the time that they can set aside for the class in question. So I will usually ask how much time the student has, so that I can tailor the discussion to reach its logical conclusion within that time frame.

Another very common problem is that a student understands the basic concepts quite well, but that they do not have much experience in problem solving. For instance, a common occurrence is that a student will be asked a true or false question, and they will try to reason it out in their head abstractly without doing a sanity check in a couple of concrete cases. I always emphasize trying a specific instance since, especially in lower-level classes, the insight you need to solve a specific instance is enough to give the general solution. It is similarly often the case that a student will freeze when asked to prove a universal statement ("Show that for all x, ..."), since there are too many cases to handle, but when presented with some specific instances of the statement, they have no problem doing the proof. Showing the student that they have the correct idea is important, not only so they can come up with the proof, but also so the student has confidence that they can tackle what seems like an infinite amount of cases.

Finally, something I see with people who are new to doing formal proofs in math is that they are not used to "unravelling the definitions" to prove something. For example, there are often students who will try to prove something about eigenvalues by using the fact that they are roots of the characteristic polynomial, instead of by using the defining equation $Av = \lambda v$. This makes sense, because whenever they need to find a concrete eigenvalue of an explicit matrix, they go through the characteristic polynomial and never use the definition. Thus I will often tell students to just try and use the definition before trying to use any propositions or theorems.

In general, what is important here is to understand *why* a student is having a certain problem, and addressing the root of that. Simply explaining the correct approach will not fix their future attempts at problems, and it can quickly lead to students thinking they are not "clever enough" for math, which is the worst possible outcome. On the contrary, I have a strong belief that there is a fairly systematic approach to problems in entry-level mathematics (such as calculus and linear algebra), and it is important for me to convey this to students.

4. Reviews from students

- "Forte Shinko is an absolute lifesaver. He is super accessible, explains things very clearly and is so nice!" (Math 6c: Introduction to Discrete Mathematics, Spring 2021)
- "Forte's recitations and notes and the consistency of the caliber of his reviews were invaluable to my process of learning linear algebra for the first time. His email response time was actually unbelievably great and so appreciated, and his ability to teach concepts and offer examples was always very helpful." (Math 1b practical: Linear Algebra, Winter 2021)
- "Your recorded recitations carried me through this course. Incredibly focused, concise, and well-explained. I have no idea how you did it, but keep it up!" (Math 1b practical: Linear Algebra, Winter 2021)