TEACHING STATEMENT

Hanbaek Lyu

It is my belief that we learn mathematical principles most effectively by actually discovering them; observe many examples and then make analogies about repeated patterns. In fact, for the sake of clarity and elegance, most math textbooks are written in the opposite order – abstract principles and formulas followed by examples. I think a great instructor should reconstruct the process of discovering subject principles from bottom up, and guide the students to discover them by themselves. Through this way of teaching, or rather, guiding and discovering together, I hope to achieve my ultimate goal as a math instructor: to teach them mathematical way of thinking.

My philosophy in teaching mathematics stems from my personal experience as a student. I spent my middle and high school years in the highly competitive environment in South Korea. High school mathematics in Korea covers up to a typical curriculum of Calculus 2 in the US, and the focus is on solving non-trivial problems quickly without making errors. I was overwhelmed by all kinds of clever tricks and formulas to memorize. As most other students do, I though math was only for the smartest those who would easily come up with such tricks by themselves. It was during a summer in high school that I spent in a buddhist temple, that I realized that everything is written backward. The dirty (but most exciting) part of the process of discovering mathematical principles was hidden behind the refined results.

During my first year as a Hedrick Assistant Professor at UCLA, including Summer 2019, I have taught seven quarter courses on probability theory, stochastic processes, and mathematical finance. I have written lecture notes for each of the courses with carefully designed exposition and exercise problems, which spans 237 pages altogether. My lecture notes are very well-received by the students at UCLA and also by international students during summer sessions. One of the characteristic of my notes is the exercise problems are designed and written: Each problem leads the students to reconstruct a non-trivial statement by following a number of quasi-trivial steps. I owe this “exercises as broken-down proofs” style to two of my greatest math teachers – Insuk Lee at Seoul National University, and Neil Falkner at the Ohio State University.

Here is how I usually organized my lectures. At the beginning of class, I first give the students a general motivation and bigger picture of what we are going to study. For instance, I would ask them what are differentiation and integration are good for. Then I say they are both studies of unknown objects via familiar ones; curves by lines and area under curves by rectangles. Then, I present a couple of examples, which are easy and concrete enough but also contains the essence of the theorem or principle. It is important to go through them with students step by step, asking questions to lead them to take the “most natural next step”. After they discover and agree on a common pattern that I intended, state the main theorem and principle in a more abstract version. At this point, students have worked out concrete examples from which they can draw analogy when looking at abstract statements. Then we work on less obvious examples, guiding students to see the abstract pattern they have discovered in different contexts. This will solidify their understanding.

Asking questions and giving examples on point are very effective in involving students in class and also in resolving their misconceptions. For instance, in a Calculus 1 class at OSU, I asked my students a limit problem of the form $\infty - \infty$. Some student said "the answer is ∞ since the first term diverges". I asked him the value of $\lim_{x\to\infty} x - x$, and he realized what goes wrong immediately. Then another student asked, "Then is $\infty - \infty$ always zero?" So I gave her $\lim_{x\to\infty} x^2 - x = \lim_{x\to\infty} x(x-1)$. She knew the answer was ∞ obviously. Some other asked what does $\infty - \infty$ even mean. I said, "It means you need to work harder." The point here is to give students the right example so that they can figure out and correct their misconception by themselves.

Here are some examples of student's comments on my teaching from UCLA and OSU:

UCLA:

1. Professor Yu explained the concepts in this course very clearly. He is a very competent and informativelecturer. He also provides very complete lecture notes that effectively stand in for the departmentassigned textbook, a welcome surprise as the exposition and organization of those notes areconsiderably better than those of the textbook. They also contain supplementary problems that helpbring each topic into perspective.
2. Professor Yu is a very effective teacher. He posts his typed out notes online which are very helpful andclearly outlined. The examples he goes over in class help with elucidating the material and providingdepth. He answers all questions to the best of his ability and makes sure everyone is on the same pagebefore moving on. You can tell he cares about students actually understanding the material anddigesting it. His relaxed teaching approach and calm personality made me motivated to learn and dowell in the class rather than feel pressured like in other math classes. His tests are very fair andreasonable. The homework is also relevant and aid in understanding the material. This class made meinterested in the topic.
3. Professor Yu was pretty great at teaching us probability. He explained everything, told us what topicswere going to be on the exams, and made sure everyone understood the material. I didn't attend anyoffice hours because they conflicted with my other obligations but I would assume if I did go they wouldjust as helpful as the lectures and notes were. His homework was relatively difficult and it did challengeme but it was doable. I do wish he gave us practice exams or just extra problems to test our knowledgebut unfortunately he didn't do that. At the end of the day, his teaching was incredibly helpful andefficient. Even though the material is a little difficult to grasp, it was all manageable thanks to theprofessor.

OSU:

1. Hanbaek is the best math instructor I have had. He has a knack for discern where students are going wrong conceptually and then addressing their mistake in a clear, non-aggressive way.
2. He is really funny and makes the material easier to learn. The way he teaches really helps "dumb down" the concepts, which is really helpful when the material is really hard. Lyu is really sweet

and if you need help or have make something up, he would spend time out of class wanting to help.

3. At first I was a bit surprised because Hanbaek has a very different way of teaching that I am not used to. Once I figured out his teaching style I learned Exponentially.
4. The instructor did a great job at clarifying topics covered in class. Difficult principles were broken down to simple and easily understood concepts. In general, I found him more helpful than the professor.

In a ladder faculty position, I envision that I will be interacting students of broader spectrum – domestic or international undergraduate students with diverse backgrounds, advanced undergraduates or motivated masters/doctoral students, or even local highschool students. I will adjust the balance between examples and theories accordingly as I interact with them. Neverthless, my principle of “guiding and discovering together” will be central to my teaching style. I believe the best way to teach how to catch a fish is to help the students catching fish on their own.