ANDREW CRITCH, TEACHING STATEMENT

I am very passionate about teaching mathematics, and my passion is not limited to the classroom. Between 2011 and 2012, I helped to form the Center for Applied Rationality (CFAR) in Berkeley, an independent non-profit organization which runs workshops for people wishing to involve more quantitative and logical reasoning in their own behavior. In particular, this requires connecting people's abstract reasoning faculties with their concrete actions and visceral intuitions. Even for mathematicians, this is not a trivial connection! I also ran a seminar in the Berkeley math department called the "Math, Productivity, Happiness, and Decision-making" seminar with essentially the same theme. It was the most-attended seminar in the mathematics department that semester. I am now also working with recent Nobel laureate Saul Perlmutter to develop a course on science and rationality for Berkeley undergraduates, for which I expect to be a graduate student instructor on the spring.

I believe I've learned many lessons about how to teach mathematics, and science in general, from experiences like these. Instead of describing these lessons in abstract terms, I'll describe some peculiar things I do and say when I teach, and how I think about those things, in order to convey my teaching philosophy as concretely as possible. One thing I've learned many times over is the value of using examples to communicate, and discussing teaching philosophy is no exception!

Things I *do* when I teach

When I teach math, I try to apply all the standard wisdom of drawing pictures, writing neatly, writing full sentences for theorem statements, repeating important results twice verbatim and at least once with rephrasing, and so on. But I also try hard to come up with my own techniques for keeping a class engaged. When teaching adults, I usually explain what teaching methods I'm using as I use them, so they feel included in the teaching process rather than merely subject to it. I find that adults are usually extremely cooperative with my quirky methods, especially when I explain how they're supposed to work.

I try to engage motor cognition when possible. For example, my first year calculus students are often confused about the difference between a function being positive versus its derivative being positive. So, I have them trace out some functions with their left hand in front of me, using the height of their wrist to indicate the value of the function, and the angle of their hand to indicate its derivative.

I also try to engage verbal cognition. When there is something I really want students to remember, I jokingly have them pretend to be zombies and repeat it as a group a few times. This both shows that I think it's important, and engages their verbal and neuromuscular memory. I also explain that the goal is understanding, not memorization, but hopefully by getting the content into their brains sooner rather than later, they might process it unconsciously somewhat and come to understand it more easily.

Sometimes I teach "BitTorrent-style". BitTorrent is an extremely successful peer-to-peer file sharing protocol whereby one obtains fragments of a file from peers which do not yet have the entire file, and only fragments that are in scarce supply are downloaded from the original file source. I sometimes apply this to teaching: when students have many questions, I sometimes give them 5 minutes to answer questions to each other, and then I take the questions which remain unanswered and explain them to the class as a whole.

Things I *say* when I teach

"I want someone who hasn't spoken yet to answer this question." Sometimes during a lecture, students don't answer questions they know because either (1) they feel the question is too easy to answer aloud, or (2) they don't want to look like they're showing off. To avoid this, I often insist that a question posed to the class must be answered by someone (voluntarily) who hasn't spoken yet. Students who find the question easy will still answer it as a service to the class if no one else does, and they will perceived as helping the class along rather than showing off. It also results in a fair distribution of class participation.

"Use your face to communicate with me." When students are looking away from the board and their notes, it may be because they find the material either too easy, or too hard, and it's difficult to judge which. So on the first day, I teach my students to use separate facial expressions for "I don't understand" and "yeah, I get this". And they do it! This gives me continual, high-bandwidth feedback from a room full of faces — much higher bandwidth than can be achieved from verbal feedback, which is necessarily lower-bandwidth because it can't be processed from everyone at once.

"Don't trust your 'I get it' reflex." Some students judge themselves to "get" material and disengage their curiosity as soon as they find their teacher's explanation *persuasive*. Others wait until they know they can *reproduce* the explanation and relevant methods for themselves. The first kind of student is prone to falling behind over the years, and eventually making reports like "I get it when you explain it, but when it's time to do the homework or an exam, I get stuck." So I try to encourage student to challenge their inner sense of "getting it" by asking what they'd do in a problem-solving situation as soon as possible.

"Be curious!" When I pose an important question to a class, I explicitly tell students, "This is important, so I'd like all of you to either (1) already know the answer, or (2) be very curious about how to do it. So if you don't know how, please start wondering now!" I have found that I am somewhat receptive to being explicitly told to be curious, and many of my students appear to have the same reaction.

Summary

- I always remember that I'm teaching human beings, not computers, and that humans can benefit from all sorts of silly tricks to help them think,
- I explain my teaching methods while I use them, so people know what's supposed to be happening and why, and
- I remain ever curious about new methods to help people learn!