CA Application

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I have CA'd CME 308 (twice), CME 102, and CME 100 (twice). For all of the courses I helped prepare questions for problem sets (except CME 100 with Dr. Khayms, as he takes care of this himself), and for CME 308 I helped prepare the qualifying exam. Below I discuss a bit of the general approach I bring to CA'ing these classes, mention some of the more fun problems I proposed to use in these classes, and finish up with some student comments I have saved.

Perhaps the most important notion I try to impart on students in office hours is to work with their intuition and not to lose sight of the big picture mathematics and physics when working out problems. Many undergraduates (including myself, when I was in college) convince themselves that they have understood a theorem because they followed the formal steps in its proof. A more mature mathematician knows that the important part is actually getting at the intuition behind those steps, and that various formalities can be taken care of easily once the big picture is understood.

Maybe I'm too young to have a teaching philosophy, but nevervetheless I think my teaching philosophy can be summarized by the fact that I never ask the question "does this make sense?", and instead opt for "are you buying it?" This may seem insignificant, but it changes the CA/student dynamic in an important way. The latter question emphasizes that I am not an all-knowing CA who is certainly correct and should simply explain the proof in such

a way so that students grasp it. Instead, it highlights that I am a fallible CA who was at one point convinced of this proof (possibly wrongly). With this, the students are called upon to be skeptics – indeed, scientists – who need to decide whether or not the argument I am proposing holds water. If it does not make sense to them, then we have more of a reason to doubt the proposition or my clarity, rather than the student's understanding of the material. I think in many office hours around campus, if a student gets two explanations of a problem and still does not understand the solution, they will let it go because they feel it is their own fault; with my approach we can talk about one problem for hours without anyone feeling insecure. The above applies for when I am arguing, but most of the time I let the students do the arguing to me or among themselves, guiding them only ever so often. The less explaining I do, the more they derive on their own. And I'll sometimes go down a wrong road on a students suggestion for quite a while until someone realizes the mis-step. Then we all have learned more. I think it works. And I can tell people are having fun. (This latter point on "letting the students do all of the work, and only guiding once-in-a-while" is more true in the undergraduate courses I CA; the CME 308 the material is hard enough that working as a group with the CA is enough of a learning experience.)

I try to propose high quality problems for homeworks and exams. Let me mention some of the most interesting ones here. Note that many of these problems are not my own, but problems I found and collected over the years. For CME 100 and CME 102, I remember proposing the derivation of the curse of dimensionality (i.e. showing the (volume of the n-sphere)/(volume of the n-cube) goes to zero as n takes off)), proving that the centroid of a triangle minimizes the sum of the ℓ_2 square distances but not the ℓ_2 non-square distances (Fermat point) with its applications in engineering, and proving that at any point in time there exists a point on the equator such that it has the same temperature as its sister point on the opposite side of the earth (a classic problem on continuity). For CME 308, I adapted two problems from research I was working on: one was about how to efficiently simulate

binomial random variables $B(n, p)$ for different regimes of n and p, and another was proving a central limit theorem in the context of mean field models.

A few comments from Axess:

CME 308:

"He was so dedicated and passionate it was impossible not to get excited about the material. I wasn't enjoying the early probability stuff (for eg) but he presents stuff in such a way that it kept me motivated and enjoying it. He also would routinely check something which was mentioned in OH and follow up with a personal, detailed analysis."

" Alex helped me understand what the problem sets were asking, and then how to approach them. He provided intuition and lucid explanations for many of the concepts were covered in class. I owe a huge amount of my learning to Alex's help during office hours, and via email and class discussion boards."

" I can't say enough good things about Alex. He is _very_ smart, came to office hours extremely prepared, parceled out hints in a pedagogically sound way, and exhibited more humanity and emotional intelligence than 99% of Stanford grad students."

CME 100/102:

"alex is amazing!! he was so dedicated in office hours and really took the time to make sure i understood concepts i was struggling with, and he was willing to put time in and work through problems to help me figure out where i was making a mistake / getting stuck! he is the best and we even got into a fun nerdy debate about math"

"Whatever approach I took to a problem, he would see through to the end. Even if it was different from how the problem was usually approached."

"Pushes me to understand the material myself rather than just talking at me"

This final quote is from an email I received after having given a lecture for CME 100.

"I just wanted to say that the lecture that you gave last Thursday was awesome and super engaging! I am not sure if you are considering becoming a Professor one day, but I honestly think that you would make an incredible professor! Listening to you lecture was genuinely fun, interesting, and engaging and you did a fantastic job of explaining all of the concepts that you were covering while providing great energy and charisma! It was just a great lecture in every way and I wanted to make sure that I let you know how much I appreciated your enthusiasm!"