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Nonlinear dynamics, aka “chaos theory” [1]

Elizabeth Bradley

CSCI 4446/5446 is a course on nonlinear dynamics—aka “chaos theory”—taught from a computer-science standpoint. Developing this course was not simply a matter of watering down the mathematics for a different audience. Computing played a critical role in the nucleation and evolution of this branch of mathematics because the associated equations cannot, by definition, be solved with paper & pencil. My vision of what an introductory nonlinear dynamics course should look like was inspired by that observation. I cover the basic ideas of the field with lots of pictures & examples, and only a few proofs, all the while highlighting the role of computers as the laboratory instruments in this field. Students go through the sequence of computational tools that were developed in order to study the fundamental problems of the field, building their own versions from scratch. As far as I can tell, this approach is unique among current nonlinear dynamics courses, which are generally “housed” in physics and math departments—and taught from those viewpoints.

I’ve taught this class more than 20 times to seniors and graduate students in the College of Engineering. In the fall of 2014, I developed a MOOC version of it that required far less technical background and offered it to 3000 students via the Santa Fe Institute’s Complexity Explorer platform. Because the depth of the two syllabi is so different, it didn’t occur to me that there could be much useful coupling between the MOOC and classroom versions of this course. I did mention the MOOC to my in-class students last spring, though, and I got a surprise a few months later in the “other comments” section of my FCQs, where a number of students wrote that the extra, low-level lectures on the MOOC site had really helped them learn the material.

I would really like to know how & why that worked—and hopefully figure out how to leverage that knowledge to improve teaching and learning. That is the goal of my SOTL project. I propose to identify a signature phenomenon: something that would indicate that the effect I’m interested in has really happened (and would be very unlikely if the effect hasn’t happened.) One possible signature phenomenon is whether the in-class students are looking at the MOOC materials at all. If they are, I can go on to ask how: just viewing the videos, taking the quizzes, etc. Most students probably will not; if they do, that is prima facie evidence that the material is useful—or at least that the students think it is. I can add to the assessment by asking for specific written feedback during the semester: what they found useful, and why. I could even use the facilities of the MOOC platform to study how they used the materials: e.g., whether they scanned a video once or came back to it repeatedly, reviewed particular sections, took the online quizzes more than once, etc.

My class is not large, so the sample sizes will be fairly small; also, the experiment will not have a formal control. Nonetheless, this study should, I hope, give me some preliminary feedback about how to use MOOC materials to support and augment in-class instruction. Ways to use online materials to improve the classroom experience are even more critical in the context of the rapidly growing enrollments that we are experiencing in computer science nowadays. Anything that helps us handle that growth while keeping the learning levels high would be a real advantage in that context.

Groups audience:
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