JOHN CALABRESE — TEACHING STATEMENT

At Rice, I have had the opportunity to teach a variety of subjects, from large service courses divided in multiple sections, to advanced graduate topics. I also have been active in participating and co-organizing learning seminars for students. I find teaching and mentoring highly edifying, and I profoundly enjoy it.

Lecturing. The first time I took on the responsibility of teaching a full course was at Rice University. In Spring 2014 I taught MATH 382 (complex analysis) and redesigned MATH 390 (undergraduate colloquium). The former had an audience of mainly juniors, while the latter was a small mix. At the time, the goal of 390 was to provide a format to practice oral presentations. I chose a set of notes developing the basics of matrix groups and I had the students cover a small chunk every week. Each student had a chance to give multiple lectures. Before each presentation, I would meet with them to discuss the contents of the lecture, and afterwards I would provide detailed feedback. It was highly rewarding to see the quality of the presentations improve dramatically as the semester progressed.

In Fall 2014 I taught MATH 354 (honors linear algebra) and MATH 465 (introduction to algebraic geometry). By teaching these two courses I had the opportunity to interact with different audiences of undergraduates. The latter course was meant for graduate students, while the former was for the most part attended by sophomores. A semester later, I was especially happy for having stumbled across a student of 354 who said that she was glad to have taken the course, as it made a notoriously difficult economics course incredibly easy.

In Spring 2017 I taught MATH 565 (a topics course) and MATH 212 (multivariable calculus). The former course covered the basics of derived categories, which are essential in my field of research. The literature on the subject can be intimidating, and for this reason I wrote a detailed set of notes, available on my website.

<div align="center">http://math.rice.edu/~jrc9/</div>

At the same time, 212 has possibly been the most rewarding course I have taught so far. There the students learn for the first time to perform calculus in higher dimensions. Many lectures require sketching on the board curves and surfaces in $\mathbb{R}^3$, in order to visualize new concepts and notions.

I am currently teaching MATH 355 (linear algebra) and MATH 565 (a topics course). The former is the less abstract version of MATH 354, which I taught in Fall 2014. I have written detailed lecture notes, available on my website. For MATH 565 I chose to cover the basics of Lie groups, Lie algebras and their representations. I also wrote notes for 565, with the goal of streamlining the background for the adopted textbook.

In Fall 2017 I was invited to Baker College *Best Professors Cocktail Party* and to Will Rice College *Favorite Professors Dinner*.

Methods. As a habit, I prepare each lecture well in advance and have a swift review just before class. During a lecture, I make sure to write as big and clearly as possible. I also make frequent use of colored chalk to underline, circle and point to important (or interlinked) material. Every new notion or fact is followed by a brief pause for questions. Two or three times per lecture, especially after treating more complicated concepts or results, I will take a longer pause. Abstraction can be confusing at times, and I find that longer pauses help in making the confusion specific, which in turn makes asking questions easier.

I try to strike a balance between explaining abstract concepts and providing concrete examples. For instance, when I introduced the notion of span of a subset I first provided motivation (e.g. "we

want to describe large subspaces with a small number of vectors"), stated the complete definition, followed it immediately with an example (e.g. two vectors in $\mathbb{R}^3$), and concluded with a rough explanation (e.g. "the span of S is made up of all vectors we can reach by adding and scaling vectors in S"). Other times I will reverse the order, and have an example or two before the abstract definition. Either way, this process is always followed by more examples.

I also conduct regular surveys (typically between two to four per semester), which supply valuable insight on the class's pace and clarity. I like to include both multiple choice questions, which are useful from a quantitative point of view, but also a comment box, so that each student can provide specific input.

On occasion, I will try to explain how a topic treated in class might relate to more advanced mathematics. I also try to reserve the last lecture to provide a glimpse of how the course as a whole relates to other topics. For example, in 354 (honors linear algebra), I talked about projective geometry and category theory. For 212 (multivariable calculus), I explained how vector potentials link to the Aharonov-Bohm effect in quantum physics and magnetic monopoles. My hope is for these bonus lectures to provide inspiration to learn more.

TA. My first experience as a teacher was actually as a graduate TA. The task was demanding, due mostly to the limited amount of time, but also rewarding since I was in direct contact with the students. Many of them struggled to ask questions during lectures, and so those sessions were a good opportunity to clarify the material presented there. I strongly sympathized with this aspect, as I myself used to be a shy student.

Mentoring. Throughout my career, I have always strived to foster an inclusive and active environment. Starting as an undergraduate, I have regularly organized and participated in seminars, and I enthusiastically encourage students and other postdocs to discuss mathematics.

In Pisa, I organized the first seminar for undergraduates, where we took turns in explaining theorems and notions not taught in the standard courses. At Imperial College, I co-organized a year-long Hartshorne reading group, and later a semester-long learning seminar on Extended Topological Field Theories. At Oxford, I co-organized a year-long learning seminar on Derived Algebraic Geometry, a semester-long learning seminar on Chromatic Homotopy Theory, and a semester-long learning seminar on Quot and Hilbert schemes. At Rice, in 2014 I co-organized a working seminar on Bridgeland Stability conditions, in 2015 I co-organized a learning seminar on the Geometric Langlands Program. That year I also helped with a learning seminar on algebraic surfaces, and in 2016 with a seminar on Étale Fundamental Groups.

In 2014-2015 I acted as a coordinator for the *Teaching Seminar*. This is part of the graduate student training at Rice. The teaching seminar consists of weekly meetings, which the students must attend during their first two years of graduate school, before being allowed to lecture.

In 2016-2017, I held weekly 90-minute-long meetings with Stephen Wolff (a student of Várilly-Alvarado), in preparation for his advanced exam. I later sat on the panel for Wolff's advanced exam. Patrick Girardet (math senior) is currently taking a year-long reading course with me, studying foundations of algebraic geometry.

Future. I feel my ability as a teacher has improved greatly since 2014, both at a logistical level (providing useful homework, presenting enlightening examples, requesting more feedback, etc.) and as a lecturer. I have a stronger command of the room and my lectures are much more engaging. I look forward to continue teaching mathematics at all levels.