Teaching statement

Darij Grinberg

Recitations. My first teaching experience was leading recitations, which I began in Fall 2007 as an undergraduate at the LMU (Ludwig-Maximilians-Universität) Munich. I have fond memories of those recitations; the interaction in the classroom was highly constructive, and I think I have genuinely gotten important ideas across. As a graduate student at MIT (2011–2016), I have been a teaching assistant to several classes, including one (Alexander Postnikov's Linear Algebra class) in which I made my own recitation materials and invented my own exercises. I believe I managed to help and improve the performance of many of my students, which came from varied backgrounds and had rather different levels of familiarity with mathematics.[1] Besides the recitations, I held office hours, took part in the grading of exams, wrote solutions to some problem sets and extra review problems, and dealt with some contingencies of grading.[2]

Classes. Since 2016, I am teaching my own classes at the University of Minnesota (1 to 2 classes per semester). All of my class materials (which, since 2017, include scans of my in-class writing) can be found on my UMN website. I have taught fairly diverse audiences, ranging from a mixed-major collective in my Applied Linear Algebra sections to a group of interested high-school students in the UMTYMP's Math 4990. I have received fairly positive student evaluations overall, with a noticeably positive gradient through the last two years. The students in my Spring 2018 combinatorics class (an undergraduate, senior-level class, not explicitly targeting math majors) have rated me consistently over 4/6 on all items, including a 5.5 on "The instructor treated me with respect"; on their written evaluations, they stressed everything from "plenty of examples" to interesting homework to the availability of lecture notes and homework solutions on the class website.

I believe in the use of student feedback to improve teaching and to address the needs of the students; and, in turn, I believe in the use of the internet and other computing technologies to facilitate student feedback. As an example of the former, some of the exercises I have been giving in my 18.06 recitations at MIT were targeted at addressing common (student) misconceptions that I had become aware of previously, and at clarifying material that I had found students shying away from. When posting solutions to homework sets, I tend to update my solutions after seeing the students' homework to

[1] I received highly positive evaluations (on a 1–7 scale): 6.2 ("Simulated interest"), 6.7 ("Displayed thorough knowledge"), 6.3 ("Helped me learn"), 5.8 (overall rating), 6.3 ("Presentations were well-organized"), 6.6 ("Instructor encouraged participation"), 6.1 ("Instructor used good examples"). One student evaluated my recitation as a "great job" and wrote that I "Picked good problems, answered questions, reviewed areas of confusion".

[2] Here (http://web.mit.edu/18.06/www/Fall14/Midterm3ReviewF14_Darij.pdf) is an example of a review problem set that I wrote. It illustrates the "double bottom" approach that I like to take, in which I both give basic material that should help struggling students (e.g., there are some explanations of how to substitute things into polynomials in the solution to Exercise 0.2) and some advanced/nonstandard material so that the high-riders don't get bored.

discuss interesting ideas and common mistakes found in the latter. Occasionally I let students volunteer their own solutions to be posted on the class website – which serves both as an extra stimulus for good writing, and as further reading for interested others.[3] (In one case, I was also able to reference a student's published solutions in a reference letter I wrote for them – another advantage of this open approach.)

I have (good) experiences with using both an MIT-managed LMS (Learning Management System) and Moodle to manage homework in a fully paperless way, with the benefit that students would receive the feedback on their work as soon as it was graded. (And, very recently, I have started using Canvas.) I also think of computer algebra systems such as SageMath (to which I have contributed code and documentation) as great tools in teaching in certain classes. In further teaching, I aspire to apply these and other techniques to improve teacher-student communication.

I am a strong proponent of open access and semi-expository writing (lecture notes and "handouts"). I regard an ideal lecture as one accompanied by publicly available lecture notes, as well as feedback channels for student-lecturer and inter-student communication[4]. I strive to achieve this ideal in teaching.[5] In particular, I am attempting to accompany this year's Enumerative Combinatorics class with typed-up notes that develop in parallel to the class, to be then used in subsequent iterations of the class.

Exposition. I believe in the value of expository texts and talks outside of class environments as well. My interest in mathematical exposition began in my early teens, when I discovered Martin Gardner's and Hugo Steinhaus's semi-popular books on mathematics in my parents' library; I have since moved into deeper waters, but retained this interest (much of my expository work can be found on my website, as well as on MathOverflow, math.stackexchange and AoPS). In my high school days, I have attended mathematical seminars organized by the German mathematical student contests (such as the BWM and the DeMO), training camps for the International Mathematical Olympiad, as well as meetings of the QED club (a society of highschoolers and undergraduates interested in mathematics, organizing mini-courses and meetings with talks given by both professors and students). At the latter, I also had my very first experience giving talks and helping organize mathematical competitions.

[3] Every student I have asked so far for their consent to publish their solutions has approved the publication, despite it not affecting their grade.

[4] Such channels are often provided by LMSes (e.g., Moodle's discussion forums), although their usefulness depends highly on their ease of use, the interest of the students, and the availability of lecturers and teaching assistants to actually visit the forums and provide expertise. I have had success with such a forum at MIT. Even without handy tools like this, a rudimental question-and-answer feedback channel can be established using email and a website, and the greatest benefit to the students comes from the availability of the lecturer to answer questions and clear up misconceptions, rather than from the use of a specific system or toolkit.

[5] The PRIMES 2015 reading project I have been mentoring led me to writing a set of notes, which are available on my website. I furthermore co-authored Victor Reiner's lecture notes on Hopf Algebras in Combinatorics, roughly doubling their size by adding exercises and a new section.

Mentorship. I have been mentoring students within the MIT's PRIMES program every year from 2012 until 2015. The program (started in 2011 by Pavel Etingof at MIT, and expanding ever since) focuses on high-school students with a serious interest in mathematics, and lets them work on real research problems under the supervision of graduate students. The rather young history of this program already boasts several publications. In my first two years, I mentored a student named William Kuszmaul (now a computer-science graduate student at MIT) on two highly successful projects, leading to one published paper and two preprints and several awards (Davidson Fellows Scholarship, Intel Science Talent Search) for the student. In 2014, I mentored a project by Eric Neyman, leading to a preprint as well which may also eventually become a paper. In 2015, due to the time constraints of my final year of graduate studies, I have downshifted to a PRIMES reading project, which aims not for a publishable result but for a learning outcome; in this project taught two high-school students the basics of algebraic combinatorics and determinants. I was one of the three "2015 Lusztig mentors".