Teaching Statement

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I strongly believe that mathematics, like any other science, cannot exist in isolation, and can only live through an active exchange of ideas between the people who pursue it. Since an important segment of the mathematics community are the students learning it, teaching is one of the most important components of the process of doing mathematics.

My teaching philosophy is based on the following ideas.

Creating a strong motivation. Each time I teach a class, I convey to the students my own enthusiasm in doing mathematics. I show them that mathematics is about studying ideas, which follow from one another in a logical sequence, and about finding the best perspective on a given aspect of reality. I tell students that the structured thought they learn can help them in many ways in their lives. Indeed, learning mathematics brings greater logical discerning to the future endeavors of the students, whatever these may be, and it offers a certain way of perceiving reality, a way of discovering its hidden beauties. I also believe that mathematical concepts and methods, in particular, should be very well motivated, and their significance as abstractions of reality pointed out. A very important role in this respect is played by the examples illustrating a concept, as well as by the applications presented; so these should be carefully selected.

Emphasizing the importance of gaining mathematical experience. I use every opportunity to make the students understand that the main goal in studying mathematics is not the memorization of certain definitions, theorems, and methods of computation, but gaining mathematical experience, reaching a certain level of maturity that will enable them to address a wider and wider range of problems on their own. What do I mean by mathematical experience? First of all, the ability to think creatively, to choose the most appropriate method(s) for solving a problem, instead of sticking to a unique method and having a rigid attitude. Mathematical experience also means the ability to use logical reasoning in proofs; one needs to see the way in which one or several results lead to others, the way in which various parts of a mathematical proof fit together, as well as the main theme in a proof or a lecture. Last but not least, mathematical experience means building on a solid background. I tell my students that learning mathematics is like the construction of a building, which has to have a solid foundation, and in which every brick has to be placed in the right position, at the right time. This is important in all aspects of teaching mathematics: when preparing the syllabus of a course and figuring out the prerequisites, when teaching a class which often consists of students with diverse backgrounds, when advising students and helping them choose the most relevant courses to their interests etc.

Active learning. I constantly emphasize this aspect over memorization, and I consider it the best way to gain mathematical experience. First of all, I consider homework a crucial part of the teaching process. Indeed, one cannot learn mathematics just by learning concepts, methods, and theorems (including their proofs), unless one is able to apply them to new problems. Thus, it is very important for the teacher to select the homework problems carefully, so that they best illustrate the material taught in class, and they have various levels of difficulty. I consider that students themselves are one of the most valuable teaching resources. I have found students willing to share their experience and explain to their colleagues something they already understood. This is extremely useful, because students can understand very well what the difficulties of their colleagues are; indeed, they encountered the same difficulties themselves. I constantly encourage the dialogue inside and outside the classroom, between myself and the students, as well as between the students. For instance, I sometimes ask students to work in small groups, and/or make presentations in the classroom (of solutions to homework problems or some course material assigned in advance); in this way, the students become more actively involved and the common errors/weaknesses are easily addressed. When students talk to each other (for instance, about the homework), a key issue is that they are given enough feedback, so that the teacher makes sure they stay on the right track.

Using technology. I believe in a hands-on approach by experimenting with mathematical software. Thus, I make use of the computer algebra systems `Sage` and `Maple` in my classes, and I am strongly involved in promoting `Sage` as a teaching and research tool in our department. In this way, I am able to better illustrate the concepts and methods (especially through visualization and demonstrations), while the students are able to use simple programs to test statements and manipulate the objects they learn about. Indeed, students are used to thinking visually and algorithmically much more than in the past. On the other hand, by letting the computer perform the calculations, one can concentrate on the essence of the problem; furthermore, the related concepts are no longer remote abstractions but tangible objects. For research students, using mathematical software is a very useful way to get introduced to research, and to discover new results through computer experiments. Most of my recent Ph.D. students are actively using `Sage` in their research.

I have not yet taught an online course, but I recognize their merits. On another hand, I have experience in using the online homework assignment systems that various publishers provide; these worked very well for me, for instance in the calculus classes I taught.

Adapting my teaching to the level and the interests of the students. I consider this a very important aspect of teaching. In my career, I have taught a variety of courses, ranging from beginning undergraduate to advanced graduate ones. In the lower division classes, I emphasize the use of various methods and techniques, while making sure that the students are able to select the most appropriate one(s) in a given situation. Since these students need the most assistance from the teacher, I constantly encourage them to ask questions, and to come to my office hours. In the upper division classes and honors classes, I emphasize mathematical proofs and the importance of being rigorous. I also take into account the special interests of the students, that is, whether they want to apply mathematics to various areas (such as physics, computer science, biology, or business), to teach mathematics, or to do research in mathematics. Thus, I illustrate the material I teach with appropriate examples related to these interests. In the graduate classes, I emphasize creativity; for instance, I show various points of view related to a given problem. I also show my students the way in which the material taught leads to current research problems, and raise their confidence in their ability to address such problems. Since it is easy to become discouraged by a research problem, I emphasize the importance of addressing special cases first, and of performing tests/experiments (sometimes by using the computer).

Paying particular attention to various concrete aspects/details of teaching. Teaching mathematics is a complex job, with many concrete aspects to take care of beside the general principles discussed above. I enumerate the ones to which I pay particular attention.

- Preparing a syllabus that includes: topics taught, grading policies (including information on homework, tests, quizzes, and the final exam), standards to be met, help resources etc.
- Treating the students as responsible adults, giving them the necessary freedom, encouraging them to become more and more independent, as well as to talk to each other and to myself.
- Using a variety of methods for presenting the material being taught: pictures, formulas, descriptive statements, algorithm-style descriptions, computer simulations and experiments.
- Accuracy in writing, good board work.

- Reviewing the homework in class. If I have a grader, I make sure to give him/her enough information about how to grade the homework.
- Making use of the computer labs and the available mathematical software.
- Being accessible to the students outside the classroom.
- Having review sessions before tests and exams.
- Treating the students fairly. In particular, I always use a grading key for tests and exams. I also make sure that the final grade best reflects the overall performance of a student throughout the semester, and that students are given enough feedback on their performance and opportunities to improve their grades.

Integrating teaching and research. I already developed several new graduate courses at SUNY Albany on some of my areas of interest (see below). I make sure that, in addition to the core material in these courses, I constantly update the additional material, depending on the interests of the students and new developments in the respective areas. I am coordinating my graduate courses with related ones taught by my colleagues in the algebra group. I believe that a very effective method to introduce students to research consists of offering independent studies and asking them to perform computer experiments involving the structures of interest. I also teach students how to write up a mathematical proof, as I find that this aspect of doing mathematics is often neglected and can hinder students. I have also given several talks in our Graduate Student Seminar, and wrote a survey paper devoted to graduates on the interactions between combinatorics and other areas of mathematics. I continue to encourage all my guests to give colloquium and seminar talks accessible to our students, as well as to interact with them.

Teaching experience

I have experience in teaching a wide range of classes, from 100 level ones to graduate courses, including honors courses, specialized topics courses, and independent studies. Following the creation of a concentration in Lie theory within our graduate program (with my colleague, A. Milas), we intend to expand it, by including both the topological and analysis perspectives. I developed graduate courses on: Coxeter groups, representations of finite groups and Lie algebras (including quantum groups and crystal graphs), Schubert calculus, and various topics in algebraic combinatorics (matroids, hyperplane arrangements, topological combinatorics, posets, the symmetric group and symmetric functions, q-enumeration of combinatorial structures, combinatorial Hopf algebras etc.). I will continue to develop graduate courses, by taking into account the interests of the students and new developments in the corresponding fields.

My evaluations prove that the students appreciate my teaching, the energy and commitment I bring into the classroom, and that I succeed in helping them learn and understand mathematics, appreciate its beauty, approach it with curiosity, and develop analytical thinking. I am happiest when students reach back to me after they graduate or transfer to other universities, either to ask for letters of recommendation, or simply to keep in touch. For instance, a former student in my undergraduate discrete mathematics class, after he transferred to the University of Michigan, regularly writes to me about his experience there, continues to ask for advice from me, and mentions the impact I had on his career, especially on his decision to pursue a career in applied mathematics.

I have supervised six Ph.D. students. One of them, Arthur Lubovsky, received a SUNY Albany Distinguished Doctoral Dissertation Award, and presented our joint work in the 2012 and 2015 editions of the international conference in algebraic combinatorics FPSAC. I have supported from my NSF grants all my Ph.D. students as Research Assistants, plus hired Arthur Lubovsky as a Postdoctoral Associate. I also offered my students travel support from my NSF grants, in order to attend prestigious conferences, workshops, and summer schools. Moreover, I received support for students or postdoctoral associates to accompany me at international conferences; for instance, such support enabled Carly Briggs to attend and give a talk at the conference *Representation Theory XIII*, in Dubrovnik, Croatia, in June 2013, as well as Arthur Lubovsky to attend the conference *Categorical Representation Theory and Combinatorics*, in Seoul, Korea, in December 2015. I am also actively involved in the recruitment of graduate students; for instance, I recruited Adam Schultze from Loyola University in Chicago. I am also currently advising an undergraduate student who will present in the Undergraduate Research Conference organized by our University in Spring 2018.

Massachusetts Institute of Technology (1996-1998):

- 18.02 - Calculus
- 18.03 - Differential Equations
- 18.314 - Combinatorial Analysisadvising two undergraduate research projects (UROP)

University at Albany (1999-present):

- AMAT 101 - Algebra and Calculus
- AMAT 108 - Elementary Statistics
- AMAT 112 - Calculus I
- AMAT 113 - Calculus II
- AMAT 118 - Honors Calculus I
- AMAT 119 - Honors Calculus II
- AMAT 221 and ACSI 221 - Introduction to Discrete Mathematics
- AMAT 327 - Elementary Abstract Algebra (including the writing intensive version)
- AMAT 328 - Introduction to Combinatorics
- AMAT 432 - Foundations of Geometry
- AMAT 331 and AMAT 531 - Transformation Geometry
- AMAT 570 - Combinatorics (graduate) - covered various topics in algebraic combinatorics, including: matroids, hyperplane arrangements, topological combinatorics, posets, the symmetric group and symmetric functions, q-enumeration of combinatorial structures, combinatorial Hopf algebras etc.
- AMAT 620 - Representation Theory of Finite Groups (graduate)

- AMAT 820 and 822 - Topics/Seminar in Algebra (graduate); among the topics covered: Lie algebras and their representations, quantum groups and crystals, reflection groups and Coxeter groups, Schubert calculus.
- AMAT 897 - Independent Study.