1. Teaching philosophy

Teaching Mathematics requires care and dedication. My primary approach to teaching is to create a *motivating, engaging and safe* environment for the students: show enthusiasm when teaching, instill interest in the topics, engage students in class discussions and make them feel safe to ask questions.

> *'Manuela Girotti is an incredible teacher that puts effort in making the course interesting. She is very enthusiastic and approachable. She explains the course material in a way that is clear and manageable. I look forward to her classes.'* (MATH NYB, Fall 2019)

I adopt the method of *think-alouds* when explaining new theories or solving new problems: I invite the students to give their opinions and I guide them to formulate a logical concatenation of evidences that will lead to the answer.

Question 6
The teacher encourages students to ask questions.

1. Agree
2. Somewhat Agree
3. Somewhat Disagree
4. Disagree
5. No Opinion / Not Applicable

Answers received

		Total	
1.	Agree	14	(77,8%)
2.	Somewhat Agree	3	(16,7%)
3.	Somewhat Disagree	1	(5,6%)
4.	Disagree	0	(0.0%)
5.	No Opinion / Not Applicable	0	(0.0%)
	Total	18	(100,0%)

Comments

Participation ballot #9 (200B0)

She is very good at answering any questions, and always responds to mio questions very quickly.

Figure 1. MATH NYB Teaching evaluations, Fall 2019. Note: MIO is the internal communication system used at John Abbott College.

The goal is to help students to develop mathematical intuition and analytical skills that can be successfully used in areas within Mathematics and beyond that. Sometimes I challenge the students by suggesting them a set of tools, that have been explained earlier, and inviting them to think about how to use them in order to solve a new problem.
I wholeheartedly empathize with the students' struggles and success to understand new concepts, and I make every effort to be receptive to the students needs (extra help in class, extra office hours, possibly one-to-one, etc.).

> *'Thanks for improving and showing you care to be here. Thanks for a good semester!'* (MATH 345, Spring 2018)

Methodology. As a general scheme, I structure the first part of a lecture into three segments:

- *quick review*: I dedicate the first minutes of the class to recall previously learned material, so that the students have a solid background to start the class with. This is an effective way to gather their attention before tackling the new material. During these daily re-loopings I

always engage with the class, in order to spot some eventual weaknesses or confusion that need to be addressed before proceeding with a new topic.

- *theory explanation*: when explaining a new concept, I refer to the textbook or the notes with clarity, but I explain the passages and the arguments in more details, so that the time spend in class is a valuable time for the students, worth investing in. On the other hand, I regularly remind the students that textbooks are extremely valuable in the review process that they should undergo after class.

  I pay careful attention to adjust my speech to the *students' receptiveness* and ask for feedback on their understanding: I often repeat important information, paraphrasing it, stressing the key ideas and using simple words. Only in a second moment, I write the concepts on the board, using specific and more formal words. This will help them to develop a solid Mathematical vocabulary which they will be able to use in writing homework in a clear and structured way, and it will be beneficial in strengthening their technical communication skills.

- *set of examples*: after illustrating the theory, I implement it in some examples. The goal is to solve at least two exercises with the active participation of the students: an easy and straightforward application and a more involved one. This way, students can acquire an intuition on the method to follow. I rarely borrow the examples from the textbook and I propose genuinely different and explanatory exercises.

  Depending on the topic, sometimes it is more convenient to start the lecture with an example, guiding the students, with a series of questions and answers, to the right solution. After the first example, the general theory is then exposed and more exercises follow.

A considerable portion of the lecture is then structured as a *flipped class* where exercise sets on recent topics are handled to the students to be solved. It is a useful tool for both the students and myself to understand to which level the concepts are understood.

'Manuela was always willing to help and answer our questions. Always available for appointments and with much respect even towards our silly questions.' (MATH 530, Fall 2018)

Question 17
The teacher is available to help students individually.

1. Agree
2. Somewhat Agree
3. Somewhat Disagree
4. Disagree
5. No Opinion / Not Applicable

Answers received

		Total	
1.	Agree	12	(80,0%)
2.	Somewhat Agree	2	(13,3%)
3.	Somewhat Disagree	0	(0.0%)
4.	Disagree	1	(6,7%)
5.	No Opinion / Not Applicable	0	(0.0%)
	Total	15	(100,0%)

FIGURE 2. MATH NYB Teaching evaluations, Fall 2019.

When teaching theoretical Math classes, I take particular care to link the topics covered in class to real word applications and to advertise the developments of theorems and techniques in

potential advanced courses. In particular, I am keen on complementing the textbook with additional material like personal lecture notes, explicative videos or stimulating web links. Complementary lecture notes, together with a collection of sample syllabi, can be found on my website https://mathemanu.github.io/teach.html.

> *'You're a fantastic teacher and despite this being a difficult course you made the material approachable. I appreciate the balance of theory and practise and I definitely felt like I learned much more than I expected.'* (MATH 345, Spring 2018)

I am finalizing some tailored lecture notes on "Random Matrices and applications to Machine Learning", which will ideally become an official "textbook" for undergraduate summer research projects or an introductory set of notes for graduate students who wishes to do research in the area. Such lecture notes are an expanded and more detailed version of a series of research lectures given at Tulane University (October 2019) and at Mila (October 2020): a preliminary version can be found on my website https://mathemanu.github.io/talks.html, together with other notes from seminars at Colorado State University.

For more applied courses (e.g. Differential Equations), I structure my course so that a portion of the lectures (and homework assignments as well) are conducted in a computer lab with the help of Python's packages and/or MATLAB for numerical experiments. For the Differential Equation II course (Winter 2022), I developed a set of interactive notes with Jupiter Notebook where the theoretical part of a course is directly integrated with its applicative part (numerical simulation, modelling, data visualization, coding, etc.). The notebooks are publicly available at this link https://github.com/mathemanu/MATH3406-Diff.Eq.2.

Finally, any time that a significant portion of the program has been covered, I dedicate a lecture to reflect with the students upon what has been seen so far and where the class is heading to, so that the learned structures are constantly reinforced.

Evaluations. Assignments are intentionally created to be more challenging than in-class exercises, in order to boost students' intuition and communication among themselves. Students are highly encouraged to discuss about the theoretical contents of the class or about their homework on an online forum (e.g. Piazza, Discord) or discussion groups. I participate into the threads by giving hints or help, when appropriate.

> *'This class is hard! [...] Lectures are educational though, instructor is good and answering questions. Homework is exceptionally challenging and graded harshly, but also educational and rewarding.'* (MATH 369, Spring 2017)

When a test date is approaching, I set up a few hours of exercise sessions outside the class schedule to meet with the students and prepare them for the exam. I remind them that they are welcome to reach out to me at any time to expose their doubts and ask for clarifications during office hours, at the end of classes or through email exchanges. I am also very careful in giving constructive feedback when grading an assignment or a test and posting a detailed description of the solutions.

> *'Dr. Girotti was extremely helpful outside of class and was throughly enjoyable to have as a professor. Dr. Girotti, thank you for a challenging semester! I learned a lot of interesting and crazy things.'* (MATH 345, Spring 2018)

In conclusion, it is my goal to provide the students with every possible facility to achieve a solid understanding of the methods and theories, so that they can not only succeed in the course, but also become independent and confident learners throughout their academic path.

'Thanks for pushing me to become a better mathematician. I can walk away form this class with a solid, basic understanding of Analysis.' (MATH 317, Fall 2017)

2. Training philosophy

I am currently focusing on the supervision of undergraduate students, in particular for summer research projects (REU/USRA) and honors thesis projects. The plan is to

(1) expose students to more advanced theories and results they would otherwise not have access to as undergraduate students;
(2) create small projects, related to the theoretical training in point (1), that they can work on.

The students will then present their work in a local seminar as well as at the Science Atlantic Conference, Canadian Undergraduate Mathematics Conferences and CMS meetings.

I would be very happy to also have graduate students, but unfortunately Saint Mary's university offers only a general Masters of Applied Science program, which is not suited for Mathematics, as among other things, the university is too small to offer graduate level courses.

My training approach is as follows: I ask students to read and study an introductory textbook (e.g., "An Introduction to Random Matrices" by Guionnet, Anderson, Zeitouni or "Solitons: an introduction" by Johnson, Drazin, Hinch). I am also actively working on tailored lecture notes on Random Matrices and application to Machine Learning, which may become an official "textbook" for summer programs.

There will be regular one-hour long meetings (about three-four times a week), where we will discuss new chapters of the textbook, possible doubts and conceptual difficulties, and we will make a plan for the upcoming week. I will also give them weekly assignments and exercises. After the students will have absorbed enough material, we move on to studying papers and working on a more concrete research project. Once a week the students will also make a presentation (about one hour long) of what they are currently learning and working on, possibly in front of other faculty and summer research students.

I already implemented this approach for an honor project when working at Colorado State U. (Spring 2018) as well as for a Summer Research Project with a USRA NSERC-awarded student at Saint Mary's U. (Summer 2022). In both cases, the students performed very well and greatly enjoyed facing and solving the challenges that the projects were posing.
For further details on these past training activities, we refer to the attached Teaching Dossier.

I believe that such a training strategy can be successfully used as an initial training for graduate students, although the involvement and difficulty level of problems to tackle will be higher and it will require some adjustments.