TEACHING STATEMENT

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Teaching Philosophy. My goal as a teacher is to help a diverse community of students *understand* mathematics by sharing with them both my enthusiasm for the subject and my knowledge. I prioritize maintaining an *inclusive*, *diverse*, *accommodating*, *respectful*, and *welcoming* classroom environment — one where everyone can participate and enjoy the process of knowledge exchange. I implement my teaching philosophy in the classroom both via traditional lecture-style teaching as well as the modern flipped-classroom style teaching. While teaching in the traditional lecture-style classes, I use well-planned lectures replete with illustrative examples and impromptu breaks for questions or small exercise sessions. While implementing the flipped-classroom style teaching, I follow the **Inquiry Based Learning (IBL)** [1] approach. I use mix of short lectures, group problem-solving sessions, and student presentations to implement the IBL approach.

Experience. I have honed my skills as an educator by teaching the following classes:

- (**Primary Instructor**) Undergraduate calculus courses for 6 semesters at the University of Michigan

  I taught taught calculus classes (Math 105 Pre-calculus and Math 115 Differential Calculus) catering to a diverse group of around 15-20 students as the primary instructor. Following the IBL philosophy, I always split my class time between *lecture* (around 40% of class time) and *group-work* (around 60% of class time; these are problem-solving sessions in small groups of 4-5 members each) respectively.

- (**Primary Instructor**) An undergraduate course titled Matrix (Lie) Groups at Universität Heidelberg

  I taught a class of 10-15 undergraduate students (50% in their 2^{nd} year, 25% in their 3^{rd} or 4^{th} years). I designed the course myself based on the books of Tapp[2] and Baker[3], both written in an undergraduate audience friednly way. The course was on matrix groups (i.e. closed subgroups of $\mathrm{GL}_n(\mathbb{R})$) and I designed it to act as a gentle introduction to Lie groups through concrete examples. For further details about the course, please see the website [4]. The medium of instruction was English.

  I taught the class through a mix of lectures and student presentations. For student presentations, I split the class into pairs and the pairs presented their material in a seminar-style talk, complete with a proper question-and-answer session at the end. Each group met with me a few times during office hours to understand and prepare their talks.

I have also had the following mentoring experiences:

- (**Mentor**) I co-mentored an undergraduate research project at **LoG(M)**, the Laboratory of Geometry, University of Michigan.

  The project was titled *Entropy degenration of ideal projective pants*. The objective was to investigate a conjectural extension of the results in Xin Nie's paper[5], possibly through computer experiments. The project eventually led to a publication [6] in an undergraduate publication by the students.

Lectures. I design my lectures to enhance audience engagement and participation. I use relatable practical examples to explain concepts, e.g. talking about velocity before segueing into derivatives. As a teaching aid, I use free online graphing software like Desmos to help my students visualize the concepts. I encourage student participation in lectures by asking questions (e.g. *"can someone remind me why we said it is a bad idea to take the derivative of $|x|$?"*) and incorporating timely pauses for student reaction and follow-up questions. As a geometer, I emphasize visual thinking — drawing copious illustrative diagrams before writing down rigorous definitions and results in my lecture (e.g. explaining continuity of functions using graphs before a definition).

> Student Comments: *"The quality of the course instruction was amazing."*
> *"... was an amazing GSI* (graduate student instructor) *and one of the best math teachers I have ever had."*

Group-work. I structure group-work based on the *'think-pair-share'* strategy of IBL [1]. I design and distribute worksheets for the in-class problem-solving session. While working on these problems, each group functions as a cohesive unit for discussion and collaboration. I circulate between the groups — listening and acting as a sounding board for the group's ideas. Sometimes I catalyze the conversation by asking leading questions (e.g. *"if two functions are continuous, is their composition also continuous?"*). During these interactions, I prioritize

being encouraging and friendly, even when I am pointing out flaws in their ideas (e.g. saying *"so what does your formula imply in this other situation"*, instead of *"your formula does not work in this other situation"*). I boost my student's confidence by acknowledging their participation and contribution publicly (e.g. *"student X asked a great question"* or *"group Y came up with a brilliant solution"*).

After finishing the group-work session, the groups present their solutions to the class. While circulating between groups, I keep track of problems that several groups struggled with. I present those solutions myself. Witnessing my students work on problems informs my choices when I design my worksheets for the class. I always design scaffolded worksheets with a gradual increase in difficulty — from textbook problems towards more conceptual ones. I often incorporate harder 'challenge problems' to foster group collaboration and check the pace of any group that has moved way past the rest of the class. Early in the semester, I sometimes have 'group-work at the board' sessions to help students adjust to the idea of group-work. During these sessions, all groups go to different blackboards in the classroom simultaneously and work together there.

> Student Comment: *"... had a great balance of helping us work through problems and encouraging us to work through them ourselves."*

IBL philosophy resonates with my personal opinion that mathematics is an art best learnt through practice and communication. Moreover, studies have shown the positive effects of IBL on student learning and closing the achievement gap for underrepresented and minority groups [1]. The classes I taught were a part of the "Introductory Calculus Program" at the University of Michigan. This program has a strong reputation for an effective implementation of IBL.

Inclusive and Diverse Classrooms. I am committed to maintaining a diverse, inclusive, accommodating, respectful, and welcoming classroom. I maintain a strict zero-tolerance policy in my classroom when it comes to treating each other equitably and with respect. I am mindful of the issues of diversity and representation when splitting my class into groups for group-work. For instance, I would try to avoid putting a single female student in a group with three other male students and vice versa. I try to apply a similar principle for students from any underrepresented or minority groups.

Students from different backgrounds may come with different levels of academic preparedness. I try to actively mitigate such a disadvantage by encouraging students to attend my office hours. I often hold extra office hours to cater to the individual needs of my students if they are not comfortable articulating their requirements in class. I often run confidential surveys in class inquiring about the students' satisfaction with the class environment, their groups, etc. I strive to ensure that every student feels that they have a voice and are stakeholders in the class. I want my classroom to be a safe, democratic, and enjoyable place of learning for each and every student.

> Student Comment: *"He was willing to meet and help you whenever you needed him. He often added office hours for us and went over his typical hour just to help us. He never got mad or frustrated with us."*

I continue learning about inclusivity and diversity in classrooms and my role as an instructor. I use the resources provided by the *Center for Research in Learning and Teaching (CRLT)*, University of Michigan, to enhance my awareness about these issues. I also learn by engaging with a broader community of instructors and sharing experiences through *Let's Talk About Teaching Lunch* and *Learning Community on Inclusive Teaching (LCIT)* at the University of Michigan. These experiences have helped me understand the needs of students from diverse backgrounds, run inclusive classrooms, and develop cultural competence.

> Student Comment: *"The classroom environment he created was comfortable, which is important in a class that involves so much group work".*

Mentoring and using my research in teaching. In Winter 2020, I co-mentored an undergraduate research project (*"Entropy degeneration of ideal projective pants"*) with Giuseppe Martone and Harrison Bray at the *LoG(M)*, i.e. Laboratory of Geometry at the University of Michigan. We co-mentored a mixed-gender group of three undergraduate students. The research project was directly related to my research in convex projective geometry.

The project had a theoretical component (helping the young researchers learn convex projective geometry) and a computational component (using computer programming to compute the entropy of projective ideal triangle groups). While assisting H. Bray and G. Martone in running the introductory lecture sessions on convex

projective geometry, I learnt the skill of explaining advanced cutting-edge research to undergraduate students in an accessible manner. I gained practical mentoring experience by hosting problem-solving/discussion sessions on convex projective geometry for our mentees. These sessions were based on IBL philosophy and were popular among our mentees because it gave them ample independence to explore.

I found the experience of sharing my research with young minds very exciting. I look forward to mentoring more young researchers in the near future. In fact, my current research inspires some interesting questions whose low-dimensional cases are well-suited for undergraduate research projects (e.g. analyzing the Gromov norm of convex projective manifolds in low dimensions via computation).

Feedback. I prioritize receiving constructive criticism and revising my pedagogy accordingly. I have invited experienced lecturers, like Dr. Beth Wolf (my teaching reference letter writer), to observe my class and provide feedback. I equally value the feedback from my students. For instance, I started appending my worksheets with some more difficult exam-like problems based on student feedback I received in Fall 2016 (my first semester as a primary instructor). Participation in conversation with other instructors via *Let's Talk About Teaching Lunch* and *LCIT* (University of Michigan) also helps me refine my pedagogical skills.

References

[1] Bennett, Hanna, Inquiry Based Learning, Early Career 2019 Collection, Notices of the AMS, August 2019
[2] Matrix Groups for undergraduates, Kristopher Tapp (AMS).
[3] Matrix Groups: an Introduction to Lie Group Theory, Andrew Baker, Springer, 2002.
[4] Matrix (Lie) Groups course (Summer 2023) website: https://mitul-islam.github.io/class/matrix_groups_2023/matrix_groups_2023.html
[5] Nie, Xin, Entropy degeneration of convex projective surfaces, Conform. Geom. Dyn. (19) 2015, 318–322
[6] DeBrito, Marianne; Nguyen, Andrew; and O'Gara, Marisa (2021) "The Degeneration of the Hilbert Metric on Ideal Pants and its Application to Entropy," Rose-Hulman Undergraduate Mathematics Journal: Vol. 22: Iss. 1, Article 3.