MATH 341: TOPICS IN GEOMETRY
FINAL PROJECT

In your final project for Math 341, you will explore and explain a special topic in hyperbolic geometry through a 15-minute slide talk prepared and presented with a peer.

Team selection. You must submit partner preferences by **Friday, 3 April**. Please send an email to me listing your first and sencond choices for partners. You can also indicate that you are open to working with anyone in the class. Please note if you have discussed being partners with a particular peer and you have both agreed that you would like to work together.

Topic selection and proposal. Your team is welcome to propose any topic related to hyperbolic geometry which is distinct from those covered in the course. (See the syllabus to get a sense of what we will cover after spring break.) If you are looking for an idea, you might want to investigate the following:

- The Iwasawa decomposition of $\mathrm{SL}_2(\mathbb{R})$.
- Hyperbolic manifolds and the Mostow rigidity theorem.
- Hyperbolic geometry of knot complements and the volume conjecture.
- Hyperbolic polyhedra (and polytopes).
- Thurston's Geometrization Conjecture.
- Hyperbolic surfaces and billiard dynamics.
- Dynamics of geodesic flow on the modular surface.
- Connections with modular forms and number theory.
- The Gauss–Bonnet Theorem (in hyperbolic and other geometries).
- Combinatorial approximations to hyperbolic space. (See §14 of Cannon–Floyd–Kenyon–Parry.)
- Rotation distance, triangulations, and hyperbolic geometry. (See Sleator–Tarjan–Thurston.)
- Physical models of hyperbolic space (polygonal, annular, crochet, *etc*.).
- The shape of space (the universe as a 3-dimensional manifold).
- Advanced topics in hyperbolic trigonometry.
- Riemann mapping theorem (and discrete versions thereof).
- The uniformization theorem for Riemann surfaces.
- Hyperbolic geometry and special relativity.

I am happy to consult on topics and help you track down appropriate references.

Your team must propose first and second choice topics by **Monday, 13 April**. Please send an email to me listing your preferences, along with one or two setences describing what you would cover and one or two resources you might draw from. Topics will be assigned first-come-first-serve to avoid duplication.

Final presentation. Your team will give a 15-minute slide presentation on your topic during our final exam period, **Wednesday, 13 May, 8A.M.–12P.M**. The talks will be presented remotely via zoom, and you will use screen sharing to show your slides. You will schedule a practice talk with me before your talk and are encouraged to incorporate feedback from that meeting into your talk. Given the time constraints, your talk should focus on concepts and theorem statements.

You can prepare slides in LaTeX using the `beamer` package, but there are also good ways to incorporate LaTeX/`MathML` into Powerpoint, Keynote, and Google slides.

You will also act as the audience for your classmates' presentations. In this role, you will provide written feedback to presenters via a Google form.

Learning goals and assessment. As you progress as a mathematician, you will need to independently learn and communicate material through presentations. Your final project will provide a structure in which to practice this skill with a peer. By giving a practice presentation, you will have the opportunity to learn from initial mistakes and improve your material.

These presentations are also an opportunity for the class to share its interests with each other and for all of us to learn about additional topics in hyperbolic geometry. For some of you, it will be the first of many opportunities to teach mathematics to others. You are expected to participate as an active audience member and to provide feedback on your peers' presentations.

Your presentation will be assessed based on the following characteristics (in roughly descending order of importance):

- Clarity of ideas and information.
- Organization and narrative.
- Clarity of slides.
- Speaking volume and body language.
- Response to audience questions.

You will also receive holistic comments on the overall quality of your presentation.

Important dates. For your convenience, deadlines and important dates for this assignment are summarized below:

- Friday, 3 April: Email team preferences.
- Monday, 13 April: Email topic proposal.
- Reading period, 4–8 May: Practice presentations.
- Wednesday, 13 May, 8A.M.–12P.M.: Presentations.