Midterm

Your midterm project will consist mainly of an oral presentation of one of the topics that you will choose from the list that you will find in this handout. I will first explain how the topics will be chosen, then how the grades will be assigned, and finally I will give a brief description of the topics.

I first want to remark that if there is a topic in geometry/topology that is not on the list and you think is interesting and we all might enjoy it, please stop by my office and we can discuss its appropriateness. Each one of you has a few days to think about what you want to talk about and to bring in a list of three topics listed in the order of preference. I will allow only two people to speak on the same topic. For those who miss their chance this time, I will allow them to do their first choice for the final project. Let me tell you now that the final project list will be the same as this one (may be expanded by two or three topics, except those papers will have to be 5-6 pages long). You may email me your preferences at any time. If your first choice has been given to two people who have submitted their choices before you, I will move to your second choice, and so on.

We will start with projects on Monday, 2/20, in alphabetical order, and there will be no excuses for absentees. Each presentation should last 10 minutes. As I said your midterm grade will consist mostly of your oral presentation. However, part of your grade will be the notes you prepared for you lecture: those are supposed to be neat, concise, readable, understandable, correct, and contain relevant information. Another part of the grade will be your evaluation of your peers. Your own evaluation and your evaluation of your peers will and should be based on the following:

Mathematics
3 pts: All mathematics is correct. All unknown terminology is explained. Presentation demonstrates an understanding of the mathematics.
2 pts: One or more of the above is mostly done well, but there are occasional minor problems with one or more areas.
1 pt: One of the above is done badly, or there are many minor problems.

Communication
3 pts: Presenter communicates material effectively. Demonstrates enthusiasm, interest, and creativity.
2 pts: One or more of the above is mostly done well, but there are occasional minor problems with one or more areas.
1 pt: One of the above is done badly, or there are many minor problems.

Organization
3 pts: The presentation is organized and method of presentation is well chosen. Ideas are connected to the topic and each other. The timing and pace is appropriate for a 10 minute talk.
2 pts: One or more of the above is mostly done well, but there are occasional minor problems with one or more areas.
1 pt: One of the above is done badly, or there are many minor problems.

Bonus
+1 point overall if the presentation was exceptional in at least two of the above categories.

When I say that part of your grade will be the evaluation of your peers I mean that I must see that you have taken that responsibility seriously, and that you have given serious thought to all these components of their presentation. If you give everybody 3 points on each of the components, you yourself are losing that part of your grade because it is impossible that everybody does perfectly!!! We will take a couple of minutes to evaluate everybody after their presentation and to write down our comments. One of the goals is to develop critical thinking about others and ourselves. To that extent each will try in same way to evalate their own presentation. Each of these evalation sheets will be turned in to me. I will not

share them with your classmates and will return them to you.

Finally, the list of projects:

1. **Infinity** You all know infinity is a little funny. But how funny is it really? Funny like this: there are infinitely many points on the line, right? There are infinitely many points on a semicircle? The same infinitely many? Or different inifintely many? Are all infinities the same? Hmm....

2. **Mathematical induction** This is a special method of proving statements. It's sort of like playing dominos: if you put them down right, you knock down one you can knock them down all.

3. **Jordan Curve Theorem** One of the fundamental concepts in topology is so simple that it sounds trivial. It concerns the way a simple curve divides a plane.

4. **Bridges of Königsberg** In Konigsberg, Germany, a river ran through the city such that in its center was an island, and after passing the island, the river broke into two parts. Seven bridges were built so that the people of the city could get from one part to another. The people wondered whether or not one could walk around the city in a way that would involve crossing each bridge exactly once....

5. **4-color theorem** How many colors does it take to color a map so that no two countries that share a common border (not merely a point) have the same color?

6. **Isometries of the plane** Isometries are maps that preserve distances. This is a wide topic and you can explore and write about all sorts of stuff here.

7. **Tessallations of the plane** Basically, a tessellation is a way to put shapes into the plane so that there is no overlapping and no gaps. One wants to put different restriction to make things more interestring, so you may want to talk about regular, semiregular, periodic, or nonperiodic tessalations, wallpaper tilings, or Penrose tilings.

8. **Symmetries of tilings** This might be a little too advanced and is connected to both 7. and 8. These are collections of isometries that preserve a certain tessalation. The example are the wallpaper tilings: these are so highly symmetric that they can be built from a single tile by using a set of rules (symmetries).

9. **Counting and area** You are given a polygon whose vertices lie on the square lattice (square grid-points whose coordinates are whole numbers) in the plane. Your task is to find a formula that relates the area of that polygon, A, and the number of points of the lattice inside the polygon, I, and the number of points of the lattice on the boundary of the polygon, B. You can do this by doing lots of examples until you find a pattern, and then proceed to prove that your guess is indeed correct one.

10. **Fractals** A fractal is an object or quantity that displays self-similarity in a certain sense. These are spaces that have FRACTIONAL dimension–how is that possible? Explore some of them, the most famous ones are Sierpinski carpet, Koch's snowflake, Mandelbrot's set, etc.

11. **Möbius band** Gluing diagram of a Möbius band, and draw a segment that connects the midpoints of the sides that are to be glued with a twist. Glue the bancd, and cut along the central circle. What did you get? What would happen if you dicided each side that is to be glued with a twist into 3 equal parts, connected the dots with a segment and cut along that circle once you make your band? What happens if you have an even or an odd number of cuts? Make conjectures, prove what you can.
If you have any more questions or concerns, do let me know.