General Information

There will be no written final exam in Math 304, instead each student will be responsible for researching and producing a final project. You are to work in groups consisting of **a maximum of 5 students.** Short presentations will be held during the final weeks of classes.

The ultimate goal is for you to have a truly enjoyable time working on your course term project. I want you to produce something that you will be proud to show your friends and family about what you've learned by taking this course.

The expectation is that every student will wholeheartedly participate in their chosen project, and come away with some specialized knowledge for the area chosen to investigate. I expect you to let your imagination flourish and to use your familiarity with contemporary technology and both high- and pop-culture to create a product that you will be proud of for years to come.

Project Details

Your project should have a story/application/context that is explainable to an audience of your classmates, and include a connection to content covered in this course. The mathematical part of your poster must include an interpretation of the mathematical symbols used within your story, and a statement of a theoretical or computational result. In short, be sure your project has (i) math, and (ii) is connected to the course in some way.

Here are some examples of possible **topics**:

1. **Analyze** another twisty puzzle (not the 15-puzzle, Oval Track, Hungarian Rings, or Rubik's cube). Come up with a solvability criteria (i.e. Fundamental Theorem), and a strategy for solving the puzzle. Discover a minimum list of moves one would need in order to solve the puzzle. Explain how commutators and conjugates were used in creating such moves. In other words, follow our template for the Rubik's cube but apply it to another puzzle.

   Examples of other puzzles are: Pyraminz, Megaminx, Skewb, Skewb Ultimate, Pyraminx Crystal, Face-Turning Octahedron, Rainbow Masterball, other shaped cuboids (i.e. 2x2x3, 2x3x3, 4x4x4, 5x5x5, ...). See table on last page for pictures of these puzzles. There are hundreds of possibilities, so pick one that you are curious about. Here is a page with many listed by name:
   `https://www.jaapsch.net/puzzles/`
   and here is the same list done by pictures
   `https://www.jaapsch.net/puzzles/indxgraf.htm`
   Also, you could look at any of the following online stores to see the wide variety of twisty puzzles:
   `https://www.thecubicle.com/`
   `https://cubezz.com/`
   `https://www.hknowstore.com/`

2. **Create an applet** that can be used as a course resource. For instance, a virtual swap puzzle with draggable tiles, or an Oval Track puzzle using more modern interactive web tools, or a 15-puzzle in which permutations are listed next to the board.

3. **Investigate** how topics learned in this course are used in other areas of math, science, engineering, computing science, art, etc. For example, cryptography, identification numbers, physics, chemistry, music, symmetry, etc. As a start, you can look at the list of articles I've posted on the very bottom of the course lectures page under "Articles for Further Reading about Group Theory":
   `http://www.sfu.ca/~jtmulhol/math302/lectures.html`.

4. **Learn** about card tricks related to the theory of permutations, and be able to explain, through mathematics, why they work. Also be able to perform them in front of an audience.

5. **Create** resources for the course (e.g. artwork for the course textbook).

6. Something else ...

This is just a small sampling of possible topics. If you have an idea for a topic feel free to run it by me early in the term and I can provide some feedback.

Once you have an idea for a topic, then you'll need to decide what medium your project will take. Here is list of possible **forms** your project could take:

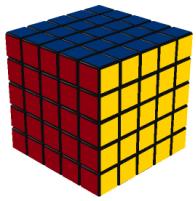
1. Create a **video** (post it on YouTube or Vimeo).
2. Create a **webpage** (publicly available for sharing with classmates).
3. Create a **virtual interactive game/puzzle**.
4. Create your own **twisty puzzle** (3D printed, or laser cut from wood, etc.).
5. Create a **proof** (or research a proof and present it).
6. Create a **play** (up to 5 minutes).
7. Create a **dance** (up to 5 minutes).
8. Create a **song** or a **music piece** (up to 5 minutes).
9. Create a **comic**.
10. Publish an **article** (in The Peak, or one of the well established math blogs, see `https://blogs.ams.org/blogonmathblogs/` for example.
11. **Enhance** the course textbook by creating Chapter images to replace the images of space, or creating new resources, or exercises.)
12. Something else...

In-Class Presentation: Each team will have 10 minutes to present their project in class at the end of the term. A schedule will be made by week 9. During this 10 minutes either the video is played, or a performance is given live, or a website is presented, or an applet is demonstrated, or artwork is shown, etc. There should be some time left for questions before moving on to the next group.

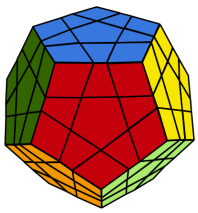
Grading

- This project is worth 20% of the final course grade.
- Your final grade will be determined using a combination of evaluations from your TA, Dr. Mulholland, and your peers.

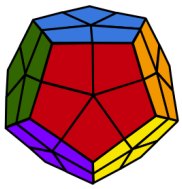
Projects will be evaluated partly on the following criteria: *creativity* of topic, *clarity* and *conciseness* of the presentation (including good graphics), *clear connection* to the mathematics, and *energy* of presentation.



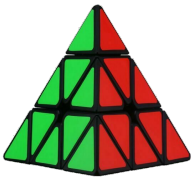
(a) Professor's Cube



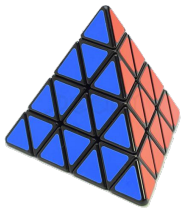
(b) Megaminx



(c) Klominx

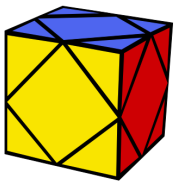


(d) Pyraminx



(e) Master Pyraminx

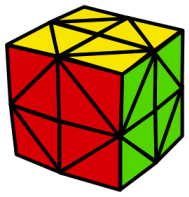
(f) Pyraminx Duo



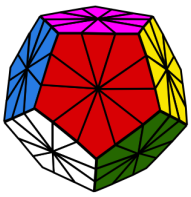
(g) Skewb

(h) Skewb Ultimate

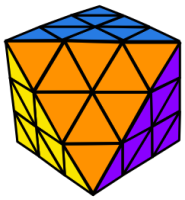
(i) Master Skewb



(j) Helicopter Cube

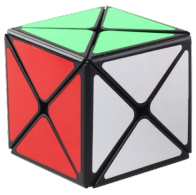


(k) Pyraminx Crystal

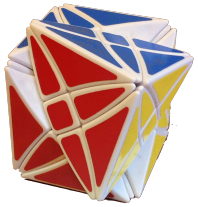


(l) Octahedron

(m) Rainbow Masterball



(n) Dino Cube



(o) Rex Cube

(p) 2x2x3 Cuboid

(q) 2x3x3 Cuboid

(r) Ivy Cube

Figure 1: Examples of Twisty puzzles.