Math 555 Final Research Project–Spring 2017–200 points
Professor Ryan Blair

Goal: Each student will explore a topic in 3-manifold topology of their choosing in more depth and present their research to class during an oral presentation. In addition, each student will submit a final paper to me by 10pm on Tuesday May 16th.

I. Paper Topic:
- Each student must choose an approved topic by **April 6th**.
- Although I am happy to consider other topics here is a preapproved list of topics
- Project topics:
    - The Geometrization Conjecture
    - The Virtually Haken Conjecture
    - The Jordan Curve Theorem and Schonflies conjecture in dimensions other than three.
    - The homological definition of Euler characteristic (Algebraic Topology by Hatcher. Section 2.1)
    - **(K)** Additivity of Bridge Number and the proof of Theorem 4.8.4
    - The recognition problem for S^3 and the proof of Theorem 5.6.1
    - Dehn Surgery and the proof of Theorem 7.4.4
    - The hyperbolic structure on the figure eight knot complement (Three-Dimensional Geometry and Topology by Thurston. Section 3.3 and Example 3.3.7)
    - Seifert Fibered Spaces (section 3.7)
    - Normal Surface Theory and the existence/uniqueness of prime decompositions for 3-manifolds. (sections 5.2 and 5.5)
    - JSJ Decomposition for 3-manifolds (section 3.8)
    - The Rubenstein-Scharlemann Graphic and the proof of Theorem 6.6.7
    - **(K)** The width of a knot and the counterexample to Theorem 4.8.12 holding for all knots
    - The quasi-geometry of the Complex of Curves and the proof of Theorem 7.7.7

I. Paper Outline (20 pts):
- Due on or before **April 18 (in class).**
- One to two pages in length, word-processed
- Open format (e.g., bulleted ideas, table, small paragraph explanation)

Your outline should accomplish the following:
- Clearly communicate the **topic**, **background**, **theorems** and **open questions** you will discuss in the paper, and
- Provide a preliminary list (at least 3) of all references that you anticipate using for your paper. Our text for the class can count as one of these references if appropriate.

II. Paper* (120 pts):
- Due on or before **May 16th , at 10 pm.**
- Length 5-10 pages, primarily word-processed, single-spaced.
- Additional pages (e.g., figures, calculations, tables) are allowed but should not be included in the 5-10 pages

Final product should contain:

5 pts	**COVER SHEET:** Provide a cover sheet with name, date, class, and title of project.
10 pts	**EDITING:** Paper is well edited (e.g., grammar, syntax), properly formatted, and meets all guidelines.
15 pts	**BACKGROUND:** All new concepts are defined and an effort has been made to frame the topic in terms of concepts we have studied in class.
60 pts	**MATHEMATICAL UNDERSTANDING:** A clear understanding of underlying mathematical topics is demonstrated.
20 pts	**CONNECTIONS AND QUESTIONS:** If applicable, connections to other areas of science and mathematics have been discussed. Major open questions related to the topic have been discussed
10 pts	**FORMATTED REFERENCE LIST:** Complete reference list (in addition to the 5-10 pages) containing at least 3 references (two must be other than an internet URL); include all references cited, as well as those used for research.

III. Presentation (60 pts):
- In class on **May 9, May 11 and May 16.**
- Remember: your classmates will be listening to MANY presentations, so try to be as creative and enthusiastic as possible
- 20 minutes
  - o Use this time to discuss the important aspects of your topic (major theorems, connections to the class, open questions)
  - o Make sure to give the appropriate background and aim your talk at your fellow students.

20 pts	Presents appropriate background
20 pts	Clearly communicates an overview of important aspect(s) of the topic.
20 pts	Questions are reasonably answered to the satisfaction of the audience.