

MAT 444 Riemann Surfaces

2024 Spring

Research Project Overview

Last updated: 4/3/24

One of the goals of this class is to provide an opportunity for students to experience mathematical research. For the first half of the semester, we are learning about various aspects of Riemann surfaces. You will each apply some aspect of that knowledge to a comprehensive and advanced research project.

Summary: You will each work in groups of 2-3 students on a research project. I have suggested some topics which you may choose from, or you may propose your own topic. The topic must have a substantial Riemann surface component, i.e., Riemann surfaces must be a core part of the project. There should be some open ended question(s) for you to work on. This doesn't necessarily mean the answer is known by no one in the world. Rather, it should be question(s) whose answers are not immediately known to you, nor clearly stated in the references that you are working from. In other words, your project needs to extend beyond reiterating or retelling what is in your main sources.

The culmination of the project will be a 15-20 page LaTeX paper (double spaced), and a **20 minute** presentation to the class.

Regular checkpoints: There will be weekly checkpoints posted to help you scaffold the project. You need to turn in something for each of these checkpoints. At the bottom of this document is a running list of the weekly tasks which I will update weekly. Note the late penalty in the bullet points at the top of the next page.

Grading: The project described herein will be worth 20% of your final grade in the class. 70% of this grade will be for your written report, 30% for your presentation.

Written Report

20% Research Assignments (~5)
10% depth of work
20% quality of writing
50% accuracy/quality of mathematics
you solved or wrote about.

Presentation

50% my grade
25% peer evaluations
10% quality of your peer comments
15% self and team reflection

Some key points:

- The early checkpoints will only be graded on effort.
- The paper will be graded on the quality and accuracy of the mathematics, adherence to all guidelines, and the quality of the writing.
- I will provide a rubric for the presentations later.
- Late work for later checkpoint will incur a one letter grade reduction per day late.
- You will all give feedback on each other's presentations and a small part of your final grade will be reflective of the quality of your feedback, as well as the feedback other students give you.

Paper Details: The final paper will be about 15-20 pages, double spaced, in LaTeX. You will need to use a style file I provide (this will make all the formats uniform). Your paper needs to include the following clearly defined sections:

- introduction
- background material and description of known results
- problem(s) or questions you attacked
- your attempts to solve the problem
- bibliography
- appendix with any code (not required, and outside the page limit numbers)

Make sure you understand the college's honesty and citation policies. We will discuss proper mathematical citations at a later date. **Due: Thursday, May 16, 2024 by 5 PM.**

Presentation Details: Each group will give one 18-20 minute presentation. You will give the presentation sometime in the last week of class. I will cut you off at 21 minutes and talks under 15 minutes will be docked a certain amount. On either Saturday or Sunday May 4 or 5, you will give me the first 5 minutes of your presentation, and I will give you feedback on the presentation. For the final presentation, each member of your group should speak roughly the same amount of time.

There will also be a peer grading component to the presentation, as each of you will give feedback on each other's final talks. **Due:** sometime during the last week of class.

Miscellaneous:

- It is possible to have a coding component to your project, but not required. The code cannot be the whole point of your project; there must be theory in your paper.
- I don't know everything about Riemann surfaces! I will help in any way I can, but all of you will be exploring topics I don't necessarily know a lot about. This is an authentic part of research.

Audience: You should write your paper and prepare your talk with other students in the class in mind as your audience (in particular, not me!).

Looking forward to next couple weeks, some tasks will be to:

- I. April 19 2-3 pages about what you did so far (or are doing) + a start of a bibliography (all in Overleaf).
- II. April 26 1 page intro + 2 pages of what you did/are doing + 2 more pages elsewhere +rewrites
- III. Presentations are May 7 and 9
- IV. May 16

3. Due: Friday, April 12 at 5:00 PM

- I. Continue thinking about background now while you don't know anything.
- II. Start digging into the open ended questions. This will be the "middle" of your paper.
- III. **Submit** (at minimum) on your shared Overleaf file 2 pages of background + 1 page description of specific problem(s) you are attacking.
- IV. By the end of this week, every group should have a specific topic finalized and open ended question(s) to attack.

2 1/2. Due: Friday, April 5 at 1:00 PM (but I won't look at it until Saturday morning at 8 AM)

Refine your project topic and find more sources. Submit on Gradescope an update to what topic(s) you are now thinking about working on and updates to open ended questions you will focus on. Your group is welcome to meet with me before this deadline to discuss topics.

2. Due: Friday, March 15 at 1:00 PM (but I won't look at it until Monday morning at 8 AM)

- I. Find three articles that might help you explore your topic. One must be very accessible, and one must scare you. All articles must be listed on MathSciNet (see class on 2/29).
- II. Come up with four questions (*quality* questions) which you think you might like to explore directly related to your topic. For example, "What is the Weierstrass ζ -function?" or "Why do we care about this?" are **not** quality questions. At least 2 of the questions should be questions that do not appear to be directly answered in your sources.

1. Due: Tuesday, March 5 at 1:00 PM (but I won't look at it until Wednesday morning at 8 AM)

We will begin the research component of this class by finding a potential research project topic and determining your groups.

- I. Look at the topics on the *Project Descriptions* file posted on the class webpage. Determine *at least 3 of them* which you are interested in working on and for any you are interested in, read a bit about each of the topics beyond the brief blurb. Or, if another topic not listed on the form is of interest to you, find 1-2 other students who are interested in a similar topic and put together a 2 paragraph project proposal with ideas of the topic you would like to study further. In addition, you should also still express interest in 3 of the predetermined projects.
- II. Fill in the form on Qualtrics (link in PWeb). You can rank your choices for the projects or you can propose your own project topic. In the latter case you may also request to work with a specific group of other students (no more than 3 total). If you pick one of the topics I suggest, I will assign groups based on general interest. The form also asks if there is anyone you are particularly interested in working with or anyone you would rather not work with, and I will make sure no one is assigned to a group with someone they would rather not work with.