Course Syllabus, Fall 2024

Course Information

Instructor Information

- **Instructor:** Ellis Hershkowitz
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Course Description

Doing research in theory and algorithms is often inaccessible because it requires an eclectic mathematical toolkit that is spread over many areas. The goal of this course is to consolidate many of these tools into a single course. Namely, this course will equip students with a mathematical foundation that will allow them to jumpstart their own theory research, particularly in algorithms. The course will cover not only many of the recurring mathematical tools in algorithms but also the ways in which these tools are used to design algorithms with rigorous guarantees. It is intended mainly for early-stage theory graduate students and advanced undergraduates. Some planned topics include polyhedral methods, metric embeddings, techniques from graph theory and the multiplicative weights framework.

Prerequisite/Corequisites

The only official pre-requisite for the class is CSCI1570.

That said, you should be "mathematically mature" and have a strong background with formal proofs. Ideally, you have some background in and comfort with proof-based algorithm design and analysis. You will also have to know the basics of probability, NP-completeness, linear algebra and calculus.

If you're unsure if you have an appropriate background feel free to reach out to Ellis to discuss!

Course Schedule and Materials

An up-to-date schedule is available on the course webpage**.** Likewise, see the webpage for homeworks, exams and notes from class.

Student Responsibilities

Students in the course will be responsible for the following:

- Biweekly homeworks.
- 1 midterm and 1 final exam (both non-collaborative).

- Attending 2 Brown Theory Seminar talks and for each attended talk submitting a short summary (~150 words) of what was learned / how it relates to anything in which the student is interested.
- Actively participating in class and giving feedback at the end of each talk actively engaging with speakers and asking and answering questions is ideal but being respectful and paying attention (not being on one's phone, computer etc.) is perfectly acceptable participation.

Student Learning Outcomes & Objectives

This course is aimed at students who are current or potential graduate students in theoretical computer science or are just otherwise curious about theoretical computer science.

The goal of this class is to provide students with a broad mathematical toolkit used by modern algorithms researchers. Ideally, students will gain the background to: jumpstart their own research in algorithms; use the algorithms toolkit in their own (non-algorithms) research as well as gain the background to reach algorithms papers at theory conferences such as STOC, FOCS and SODA.

Grading Policy

60% of students' grades will be the average of their homework grades.

30% of students' grades will be the average of their 2 take-home

10% of students' grades are based on theory seminar participation. 5% for each seminar.

5% of students' grades will be based on the extent to which the participate in class (ask)

10% of students' grades will be based on class participation.

Note the >100% sum. Grades will be assigned using the usual breakdown (A is 90% or higher, B is 80% or higher etc.). I may also curve upwards depending on averages.

Homework Policies

Homeworks *must* be typeset in LaTeX. You may collaborate on problems together in groups of up to three. You may use computational mathematics tools to assist you (E.g. WolframAlpha, Maple, etc.). You may not use search for answers to homework problems online. You may not use ChatGPT or other LLM tools. Each of your homeworks must state who, if anybody, you collaborated with on the homework. Homeworks should be turned in via TBD. Any homework that does not abide by the above will receive a 0.

Homework Late Days

You have five (5) late days to use on homeworks as you see fit. If you have no remaining late days and your homework is turned in late, you will receive a 0 for it.

Accommodations

If you feel you have a disability that could affect your performance in the course, please contact SAS and ask them to contact Ellis. Ellis will do whatever he can to support recommended accommodations.

Student Well-Being

Doing theory is extremely difficult if you aren't feeling physically and mentally well, included and supported by your peers and mentors or otherwise marginalized.

The hope is that this is a welcoming and inclusive course. If you feel you have been mistreated please feel free to contact Ellis directly or consider reaching out to some of the student advocates in the department. If you feel you might be the victim of harassment, consider reaching out to the Brown Title IX Office.

If you feel you are overstretched or otherwise psychologically distressed consider reaching out to Brown CAPS. You may also find these resources from Brown Health and Wellness (and links therein) useful.