Course Syllabus, Fall 2023

Course Information

Instructor Information

- **Instructor:** Ellis Hershkowitz
- **Office:** CIT 507
- **E-mail:** david_hershkowitz@brown.edu

Course Description

Graphs are one of the most powerful and flexible algorithmic tools. Likewise, graph algorithms remains a primary focus of modern algorithms research. This course will sample major results from contemporary paradigms of graph algorithms. Particular attention will be paid to techniques in graph sparsification and how these techniques have helped to recently solve open problems in algorithms. Planned topics include: metric embeddings, expander decompositions, iterative rounding, edge-degree constrained subgraphs and palette sparsification.

This course is aimed at current and potential future graduate students considering proof-based research in algorithms. Each student will be responsible for reading and presenting a paper with the goal of better understanding how contemporary research in theoretical computer science is both done and best communicated.

Prerequisite/Corequisites

The only official pre-requisites for the class is either CSCI1570 or CSCI1550 (CSCI1450 also works).

That said, students who take this course should be “mathematically mature” and have experience with formal proofs. Ideally, students will have some background in and comfort with proof-based algorithm design and analysis. A strong background in probability will also be helpful for many of the papers. Linear algebra is useful for two of the papers in the class.

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

Course Logistics

Ellis will give the first two talks. The first talk will give an overview of course logistics as well as an overview of the papers in the class. The second will give background on how to read, present and listen to theory papers as well as an example talk summarizing an algorithms paper.

Each of the remaining (10) classes will focus on 1 (mostly) contemporary algorithms paper. Students will fill out a form of their favorite papers and then be assigned to one of these 10 papers; this form will be sent out after shopping period. Some papers may have pairs of students assigned to them (pairs of students will be assigned to the longer and or more challenging papers). Students will then be responsible for giving a talk to the class summarizing the results of the paper (either alone or in a pair). At the end of each talk we will discuss as a class what went well and what could be improved in the talk. Students will meet with Ellis a week before their talk to practice (the first half of) it with him.

An up-to-date schedule, including which students are responsible for which papers and which papers will be presented in which classes is available on the course webpage.

Course Materials

See the course webpage for relevant papers.

Student Responsibilities

Students in the course will be responsible for the following:

- Filling out form of preferred 3 papers after shopping period
- Reading assigned paper
- Preparing and giving talk on assigned paper with at least 6 pre-prepared questions
- Scheduling a time the week before talk to practice the introduction portion with Ellis
- Actively participating in class and giving feedback at the end of each talk

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 a sense of how research in theoretical computer science and specifically algorithms is done by way of practicing three key aspects of doing theory research: reading theory (research papers), presenting theory (research papers) and listening to presentations of theory (research papers).

By the end of the course students will ideally come away with strategies for:

- efficiently reading highly technical papers (in theoretical computer science) and, in particular, learning how to condense lengthy technical papers into reusable intuition;
- delivering effective talks on highly technical material (in theoretical computer science) and, in particular, talks that simplify essential information in a way that is conducive to audience learning;
- engaging with talks on highly technical material in a way that is conducive to building reusable intuition.

Grading Policy

90% of students' grades will be based on their presentation as determined by the rubric given on the course webpage. Ellis will give back students a filled-out rubric shortly after their talk.

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

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.