Course Information

1 Introduction

Lectures will be held in the room GDC 2.210 from 3:30 to 5 p.m. on Mondays and Wednesdays.

Instructor: Dana Moshkovitz GDC 4.432
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TA: Ruizhe Zhang
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2 Textbook

The primary written reference for the course is the latest edition of

> Sanjeev Arora and Boaz Barak, Computational Complexity – A Modern Approach, Cambridge University Press, 2009.

3 Prerequisites

The perquisite is the undergraduate class *CS 353 Theory of Computation* or equivalent. In particular, we will assume knowledge of the first chapters of the Arora-Barak book: Chapters 1, 2, 3, 4, 7.1-7.4, and the beginning of 8.

4 Syllabus

- Polynomial hierarchy and time-space lower bounds
- Approximate counting and Toda's Theorem
- Relativization, Baker-Gill-Solovay
- AC0 and switching lemma
- Razborov-Smolensky
- NEXP vs. ACC0
- Communication complexity

- Randomization and derandomization
- Pseudorandom generators and error correcting codes
- Derandomizing space-bounded computation and expanders
- Derandomizing polynomial identity testing implies circuit lower bounds
- Natural proofs
- PCP and hardness of approximation
- Proof of PCP theorem: Hadamard code and an exponential PCP

5 Final Grade

The final grade will be based on problem sets and a final project. The grading breakdown is as follows:

Problem sets	40%
Proposal	10%
Project	50%

6 Final project

Students will work individually or in pairs to complete a written final project and an oral presentation of it. The final project should: (1) focus on a *research frontier* in at least one of the topics discussed in class; (2) include a through literature review; (3) have a strong technical component, either in the form of original research, or in the form of insightful exposition of existing work.

The choice of topic and relevant paper(s) must be done in coordination with the instructor, and a formal written proposal must be submitted, presented and approved by the instructor. The proposal must include the desired topic, the paper(s) on which the project will be based, a description of the research problem or the technical result that will be studied, and a brief review of related work.

To give you ideas for possible projects we will suggest relevant papers on Piazza. We expect each student to come to office hours at least once to discuss their project ideas.

The timeline of the project is as follows:

March 25	Project Proposals due
March 30-April 1	Proposal presentations
April 22	Projects Due
April 22 - May 6	Project presentations

7 Collaboration policy

You are allowed to collaborate on homework, however we ask that you dedicate enough time to think about each problem by yourself before consulting others. Moreover, even while collaborating **you must write up the solution on your own**. You should identify your collaborators on problem sets, and if you did not work with anyone, you should write "Collaborators: none." If you obtain a solution through research (e.g., on the web), acknowledge your source, but write up the solution in your own words.