Course Information

1 Staff

Lecturers: Dana Moshkovitz 32-G606
dmoskov@mit.edu
Henry Yuen 32-G614
hyuen@mit.edu

Office hours by appointment.

2 Textbook

The primary written reference for the course is the third print of the textbook:


3 Prerequisites

The perquisite of the class is the graduate class 6.840J/18.404J theory of computation which covers the first chapters of the Arora-Barak book: Chapters 1 (Basic Complexity Classes), 2 (NP and NP Completeness), 3 (Diagonalization), 4 (Space Complexity), 7.1-7.4 (Randomized computation), as well as the beginning of Chapter 8 (Interactive Proofs).

Students who did not take 6.840J/18.404J, but took and did well in the undergraduate class 6.045J/18.400J or other basic complexity class, are welcome.

4 Lectures

Lectures will be held in room 4-153 from 2:30 P.M. to 4:00 P.M. on Tuesdays and Thursdays. The course webpage shows the tentative schedule of lectures and readings.
5 Syllabus

- Polynomial hierarchy and time-space lower bounds
- Approximate Counting
- Toda’s Theorem
- Relativization, Baker-Gill-Solovay
- Boolean circuits, Karp-Lipton theorem
- AC0 and switching lemma
- Razborov’s monotone lower bound
- Natural proofs
- NEXP vs. ACC0
- Rigidity
- Communication complexity (disjointness lower bound, Karchmer-Wigderson games).
- Random walks, RL, undirected connectivity
- SL = L
- Pseudorandom generators
- Derandomizing polynomial identity testing implies circuit lower bounds
- PCP and hardness of approximation
- Parallel repetition
- Optimal inapproximability results, Unique Games Conjecture

6 Course website


The course website contains the schedule of lectures and readings, the problem sets, the lecture notes, corrections made to the course materials, and special announcements. You should visit this site regularly to be aware of any changes in the course schedule.
7 TQE

Graduate students who already took 6.840J/18.404J or equivalent may count 6.841J/18.405J toward their TQE instead of 6.840J/18.404J.

8 Problem sets

There will be 8 problem sets during the semester with two problems in each. Always submit your assignment to Henry in the beginning of the appropriate lecture. Keep a copy of your solution, since one of the students in the class will grade your problem set.

Mark the top of each sheet with the following: (1) your name, (2) the question number, (3) the names of any people you worked with on the problem (see Section 12), or “Collaborators: none” if you solved the problem completely alone.

9 Grading Assignment

Each registered student is expected to grade one problem set for a portion of the class. The graders will get the solutions to grade from Henry together with a model solution, and are expected to submit the graded solutions to Henry within a week. Each problem part should be marked as either: (3) Perfect solution; (2) Mostly correct solution but with minor mistakes; (1) A very flawed solution with some correct ideas; (0) Missing/completely wrong solution. In addition, concrete mistakes should be marked and explained. The purpose is that the students get a fair and useful feedback on their solutions.

10 Final Grade

The final grade will be based on the problem sets and the grading assignment.

The grading breakdown is as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Problem sets</td>
<td>80%</td>
</tr>
<tr>
<td>1 Grading assignment</td>
<td>20%</td>
</tr>
</tbody>
</table>

11 Questions and Answers

We will use Piazza for questions and answers during the semester. Please enroll at https://piazza.com/class/i5olq0fm6u24e5.
12 Collaboration policy

The goal of homework is to give you practice in mastering the course material. 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, you must write up each problem solution by yourself without assistance. You are asked to identify your collaborators on problem sets. 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. It is a violation of this policy to submit a problem solution that you cannot orally explain.