Lectures: Tuesdays & Thursdays 11:00-12:30, room 32–144.

Instructor: Ronitt Rubinfeld, ronitt@csail.mit.edu, G32-698.

Teaching Assistant: Lily Chung, lkdc@mit.edu

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Course Website: http://people.csail.mit.edu/ronitt/COURSE/S26/index.html

Piazza: https://piazza.com/mit/spring2026/65420

Office hours: TBD

Course topics The course will consist of a subset of the topics mentioned below. The list is subject to change due to my personal whims, class interest and timing issues. The topics will not be covered in the order given below.

- Some uses of randomness: algorithms (parallel algorithms, small space algorithms for graph connectivity, uniform generation and approximate counting, property testing), probabilistic proofs and constructions of combinatorial objects (e.g., expander graphs, Lovász Local Lemma, efficient codes, Szemerédi partitions).

- Randomness vs. predictability:

  - Computational learning theory (predictability): learning vs. predictability, learning constant depth circuits, learning decision trees, learning noisy parity functions, weak learning, boosting.

  - Pseudorandomness (unpredictability): pseudorandomness vs. unpredictability, pseudorandom generators (PRGs) based on hard problems, derandomization, randomness from weak random sources, randomness extractors, extractors vs. PRGs, techniques for recycling randomness, derandomizing space bounded computation, sample spaces with limited independence, deterministic connectivity in logspace.

- Tools: Influence of a variable on a function, random walks on graphs, expander graphs, list decoding, limited independence, Fourier representation of a function, simple additive number theory, Szemerédi regularity lemma.

Course Requirements Homework sets (35%). Quiz (35%). Scribe notes (15%). Class participation (15%). As part of class participation, students will be asked to help with grading of assignments and the preparation of solution sets.

Scribe policy The first version of the scribe notes is due *two days* after the lecture. The final version is due *one week* after the lecture. A sample scribe tex file is available on the course website. Both tex and pdf files should be emailed to the course staff.

Homework policy There will be five homework sets. Homeworks should be written in Latex and uploaded as a PDF file (instructions for uploading coming soon). See the Collaboration and LLM use policies.

Grading policy Graders will be asked to meet with Lily to plan rubrics, and to finish grading within a week after the assignment is due. After finishing, the graders should meet with Lily again to summarize and discuss. Graders are responsible for preparing a correct solution sheet (in Latex) including common mistakes and alternative solutions, though they may decide to use one of the submitted solutions (with permission from the student).

Quizzes There will be one midterm quiz. No notes, books, calculators or other resources will be allowed during the quiz. There will not be a final.

Collaboration policy

- You may collaborate on homework problems with any other students who have not already solved the problem. **You must clearly indicate who you collaborated with**, in writing, on each problem you turn in. If you did not collaborate with anyone, write "Collaborators: None" for that problem. No points will be deducted, no matter how many people you work with, as long as you are honest.

- You may discuss the problems with your collaborators, but must **write up all of your solutions independently**.

- You **may not seek out answers** from other sources (the internet, bibles, solutions from other courses, etc). It's ok to look up famous sums and inequalities that help you to solve the problem, but don't look up an entire solution. If you already knew the answer to one of the problems (call these "famous" problems), then let us know that in your solution writeup – it will not affect your score, but will help us in the future.

- You may not use LLMs (e.g. ChatGPT, Claude, etc.) in any way for your homework—see the LLM use policy.

LLM use policy

- **You may not use LLMs in any way for your homework.** This includes inputting questions on the homework, asking an LLM for hints, using it to evaluate your answers, or even using an LLM to help with formatting or grammar.

- **You may not use LLMs in any way for peer grading or preparing solution sheets.**

- **You may not use LLMs in any way for writing scribe notes.**

- You may use LLMs however you like otherwise, e.g. for help understanding the lecture material. Be aware that LLM output is often inaccurate, so you rely on them at your own risk.

Prerequisites 6.1220 (aka 6.046, 18.410) or 18.400 (aka 6.1400) or 18.404 (aka 6.5400), or permission of instructor.