18.204: Seminar in Discrete Math, Fall 2026

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Communication Specialist: Matthew Halm (halm@mit.edu)
Class Schedule: Tuesday and Thursday 11:00am-12:30pm in 56-162
Office Hours: 4-5pm Monday, room 26-142, Wednesday 4:30-6 room 26-139 (please email for Wed times) or make appointment for other times.

Course Description.

In a seminar, mathematicians help each other to learn a body of material. The main object of this undergraduate seminar is for you to help each other learn about **combinatorial learning theory** while simultaneously helping each other to better present, discuss, write, and read mathematics. To this end, you will take turns collaboratively presenting sections from a textbook or research papers to each other, and you will also write a 10-page expository paper on a topic of your choice. Topics include classical ideas such as:

- PAC Learning and the VC dimension
- Online Learning and the Littlestone dimension
- Differentially Private Learning
- Boosting
- … along with more recent research papers in the field.

The main course deliverables will be:

1. A 40-minute chalkboard presentation based on textbook or course notes material. You must meet with me/Matt to get feedback on your presentation before presenting.
2. A 40-minute slide presentation on material from a research paper.
3. A 20-minute presentation (slides or chalkboard) on the topic of your final paper.
4. A 10-page expository paper on a topic of your choice. This will be completed in stages. You will propose a topic or choose one from the provided list (available by 9/17), write a partial draft for feedback from me, complete the paper, submit it for feedback from peers, critique the drafts of two of your classmates, and submit the final version of the paper. The paper does not need to contain original work, but the writing must be your own and all sources must be properly acknowledged.
5. Five small problem sets based on the course material. These are to ensure you understand the material (especially in the first few weeks of the class) as it builds on itself.

Textbook and Material

We will follow some chapters from *Understanding Machine Learning* by Shalev-Shwartz and Ben-David, available freely at this link: https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/copy.html
Further materials will be given in the course schedule. The full course schedule is available here:, including the schedule of assignments and descriptions of the content for each presentation. Please sign up for your presentations in the spreadsheet here.

Prerequisites

The formal prerequisites are ((6.1200 or 18.200) and (18.06, 18.700, or 18.701)), and it is important that you have a solid understanding of discrete probability.
You should be comfortable with tail bounds (Markov, Chebychev, Chernoff bounds); see for example Ankur Moitra's notes.

Since the topics of this course will build upon each other, it will be essential to stay on top of the material throughout the semester.

Attendance in this course is mandatory. More than two unexcused absences, or missing the day of your presentation without a letter from S^3, will result in a failing grade. Note that conflicts with other courses and job interviews do not count as excused absences. Examples of excused absences include athletic conflicts and religious observances, which you should email me about at least 2 days in advance (and ideally at the beginning of the semester). If you cannot attend due to illness or other unexpected reasons, please email me a letter from S^3.

Class Participation Roles and Feedback In addition to attending class, you will be expected to actively engage in class discussion. To encourage participation, students will be assigned the roles such as the following (expect to perform each role around once):

- Scribe: take and type up notes from the class presentation.
- Designated novice: Ask at least once about a step that could benefit from more explanation.
- Nit-picker: Point out any notation or mathematical errors (focus on ones that can be confusing).
- Hypothesis tester: Pick one interesting way to weaken the assumption of a result presented. Try to figure out if/how the result breaks, and show a counterexample if possible. Share your findings or ask for the presenter or class's thoughts at the end of the presentation.

- Example generator: Find a simple example demonstrating the main result.
- Freebie conceptual questioner: ask a conceptual question of your choice, for example, about how the material is related to previous presentations.

For the hypothesis tester, example generator, and conceptional questioner, if you are concerned about coming up with a question in real time, you may look at the material in advance to prepare.

Additionally, everyone will be expected to give feedback at the end of each class session, using the feedback form.

Grading

- 50% talks. (20%, 20%, 10% for each talk)
- 15% attendance (5% being on-time + present (no phones or laptops!)), participation roles (1% each role), and feedback to presenters (4% total)
- 10% problem sets (2% / pset)
- 25% final paper, including drafts and peer critique (2% proposal, 5% partial draft, 5% complete draft, 3% peer critique, 10% final draft)

Late Submission Policy

Late problem sets will not be accepted. However, your lowest problem set grade will be dropped.

AI Usage Policy

The goal of this course is for you to learn to plan and execute a presentation, and to write an academic-style paper. If you delegate those tasks to AI, you will not learn them yourself. You may use AI to help you understand the content of the sources of your presentation or paper, and to choose topics and sources for your final paper. AI may NOT be used to write any part of the presentation or paper itself. The exception is for generating figures or formatting. Any use of AI should be stated in the AI disclosure section of the paper or at the end of the presentation. The MIT guide here gives guidance on what information to collect for your disclosure. I encourage you to be in the practice of well-documenting your AI use, both for your own organizational benefit, and for academic integrity reasons.

The problem sets will be useful to check and bolster your understanding of the course material, which builds on itself. Thus I encourage you to try to solve the problems independently or with your peers, though you may use AI for brainstorming. Attach to your pset the prompts and outputs you gave to AI, along with a note on how you used them.

If you are unsure if a use of AI is acceptable, please consult with me. Misuse of AI, including direct copying, will be considered academic dishonesty (I will consider the same standard for AI as for peers).

Writing support: In addition to the feedback from me and your peers, help with presenting and writing is available from the mathematical communication specialist, Matt Helm (halm@mit.edu). General help with writing and presenting (not specific to mathematics) is available from MIT's Writing Center.

Student Support Services (S3)

Personal and medical issues can make it hard to focus on academics. If you find that something is getting in the way of your ability to attend class, complete work, or take an exam, you should contact a dean in Student Support Services (S3). The deans will provide you with support and help you work with us to determine next steps. We ask that you go to S3 so we know you have had a chance to talk through your situation with someone and to connect with any resources you might need. You can reach out to a dean you have worked with in the past, join their virtual help queue (https://sicp-s3.mit.edu/queue), or e-mail s3help@mit.edu.

Disability and Access Services (DAS)

MIT is committed to the principle of equal access and we want all students to feel welcome here. Students who need disability accommodations are encouraged to contact the Disability and Access Services team prior to or early in the semester so that accommodation requests can be evaluated and addressed in a timely fashion. Even if you are not planning to use accommodations, it is recommended that you meet with DAS staff to familiarize yourself with the services and resources of the office. You may consult with Disability and Access Services in W20-507 or via email at das-student@mit.edu, or via phone at 617-253-1674. If you have already been approved for accommodations, please contact me early in the semester so that we can work together to get your accommodation logistics in place.