18.901 - Introduction to topology - Spring 2025

Instructor: Alex Pieloch
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Office Hours: TBD

Class meeting time: Tuesdays and Thursdays from 1:00-2:30 pm in room 2-190.

Course description: This course serves as an introduction to topology. The first part of the course will focus on point-set topology, covering topological spaces, continuous functions, connectedness, compactness, and separation properties. The second part will focus on manifolds and imbeddings in Euclidean space. The third part of the course will focus on algebraic topology, covering fundamental groups and additional topics as time permits.

Prerequisites: The "official" prerequisite is real analysis (18.100A, 18.100B, 18.100P, or 18.100Q). The "unofficial" prerequisites are a strong background in set theory and the ability to write clear, coherent proofs. Some real analysis and group theory will be used in the course. These subjects are not explicitly needed to take the course; however, the elements that we need will be rapidly covered. So some prior exposure may be helpful.

Course webpages: The webpage `math.mit.edu/~pieloch/18.901-spring-2025` will be used for posting lecture notes, homework assignments, exam solutions, etc.. Canvas will be used for communication and gradebook management. Gradescope will be utilized for homework submission, homework grading, and exam grading.

Reference materials: Lecture notes will be posted shortly after each lecture. There is no official textbook for this course. however, you may find the following texts helpful:

- James Munkres *Topology*, 2nd edition (ISBN: 978-0134689517)
- James Munkres *Elements of Algebraic Topology*, 1st edition (ISBN: 978-0201627282)
- Allen Hatcher *Algebraic Topology*, `https://pi.math.cornell.edu/~hatcher/AT/AT.pdf`

Homework: There will be weekly homework assignments. Homeworks will be assigned Thursdays after class. Homework will be due the following Thursday at 11:59 am (approximately 1 hour before class). Homeworks will be submitted by students via Gradescope. Any exceptions to this homework schedule will be noted for students in class and on the course webpage.

Collaboration policy: Students are welcome to discuss and work on homework problems with fellow students. However, the solutions that a student submits should be their own and written up by themselves. If students collaborate with any other students, then they should note their collaborators on the top of their homework solutions.

Late homework policy: Students will be granted two 72 hour extensions on any particular homework assignments. To utilize these extensions, students can simply submit their homeworks within this late period window on Gradescope. Outside of these two exceptions, late homework will not be accepted and the late homework will be given a zero. These extensions are only intended to account for possible severe illnesses, emergencies, and unexpected conflicts.

Technology policy: Computer use is not allowed on problem sets. In particular, the use of large language models (ChatGPT etc.) is not permitted. Moreover, "Googling" a solution or asking for a solution in an online forum is not permitted.

Exams: There will be two in-class midterm exams and a cumulative final exam. The dates for the midterm exams are given below. The final exam will be in-person during the final exam period (5/16-5/21).

- Midterm 1 - Thursday, March 6th at 1:00-2:30 pm
- Midterm 2 - Thursday, April 17th at 1:00-2:30 pm
- Final - TBD

Exam conflicts: If students find that they will have a conflict for an exam, then they should reach out to pieloch@mit.edu as soon as they are aware of a potential conflict. For disability accommodations or predictable, excused absences for the midterm (due to religious trips or MIT-sponsored activity), we will require a week's notice. For medical emergencies (waking up severely ill), we will require a note from MIT medical. For non-medical emergencies, we will require a note from an S^3 dean. Scheduling conflicts or workload management issues don't qualify for accommodations.

Disability accommodations: Students who need disability accommodations are encouraged to speak with Kathleen Monagle, Associate Dean, and Disability and Access Services (DAS) prior to or early in the semester so that accommodation requests can be evaluated and addressed in a timely fashion. If you have a disability accommodation letter from DAS, please speak with the Mathematics disabilities accommodation coordinators, Sapphire Tang (stqc@mit.edu) and Hailey Lloyd (hlloyd@mit.edu), in Math's Academic Services office as soon as possible to make arrangements for the semester.

Regrading policy: If a student feels that a problem on either a homework or an exam was incorrectly graded, then they may request a regrading of the assignment via Gradeschope. To be considered, a regrading request must be received within a week of the assignment's return date. For example, if a homework or exam was returned on a Wednesday at 4pm, then students would have till the following Wednesday at 4pm to request a regrade. If an assignment is regraded, then the entire assignment may be regraded, not simply the problem in question. When requesting a regrade, students should indicate what they believe was incorrectly graded and provide some justification for why they believe this.

Grading: The final course grade will be determined by the following weighting:

- Homework: 1/3
- Midterm 1: 1/6
- Midterm 2: 1/6
- Final: 1/3

Academic Honesty: Copying your written assignments from somebody else's assignment or from any other source is considered cheating. Any cheating on assignments, midterm exams, or the final exam will be dealt with severely.

Schedule: The tentative schedule for the course is below. It is subject to change as the course progresses.

Week	Day	Topics Covered
1	2/4	Introduction, topological spaces, bases
	2/6	Metric spaces, subspaces, product spaces, quotient spaces
2	2/11	Continuity
	2/13	Limits and continuity, connectedness
3	2/18	**No class** (Monday class schedule)
	2/20	Connectedness, compactness
4	2/25	Compactness, Hausdorff spaces
	2/27	Normal spaces, Urysohn's Lemma
5	3/4	Metrization theorems
	3/6	**Midterm 1**
6	3/11	Manifolds, paracompactness
	3/13	Manifolds, paracompactness, covering dimension
7	3/18	Baire's theorem, embeddings of compact metric spaces
	3/20	Embedding theorems, homotopy
8	3/25	**No class** (Spring break)
	3/27	**No class** (Spring break)
9	4/1	Group theory
	4/3	Group theory, fundamental groups
10	4/8	Fundamental groups, change-of-basepoint, induced homomorphisms
	4/10	Fundamental group computations
11	4/15	Fundamental group applications
	4/17	**Midterm 2**
12	4/22	Simplicial complexes, simplicial approximation
	4/24	Homological algebra
13	4/29	Homology, induced maps
	5/1	Invariance of homology I
14	5/6	Invariance of homology II
	5/8	Applications of homology I
15	5/13	Applications of homology II