MA 109A: INTRODUCTION TO GEOMETRY AND TOPOLOGY

FALL 2025

Instructor: Seung-Yeon Ryoo (she/her, sryoo@caltech.edu)
Lectures: Monday, Wednesday, and Friday, 10:00 AM – 10:55 AM, Linde 187
Office hours: Thursday 3:00 PM – 4:00 PM, Linde 258 (additional hours available upon request)

Teaching Assistant: Luis Carlos Soldevilla (lsoldevi@caltech.edu)
Office hours: Wednesday 4:00 PM – 5:00 PM, Linde 306

Course Description: Aspects of point set topology. Introduction to geometric and algebraic methods in topology.

Prerequisites: Ma 2 or equivalent. It is recommended that Ma 5a and Ma 108a are taken previously or concurrently.

Main textbook: *Topology* by James Munkres, Pearson, 2018 (2nd Edition).

Supplementary reading:

- *Algebraic Topology* by Allen Hatcher, Cambridge University Press, 2009.
  - A standard reference on algebraic topology. If time permits, we will start discussing material here. The electronic version is legally available at https://pi.math.cornell.edu/~hatcher/AT/AT.pdf.
- *General Topology* by John Kelley, Springer Graduate Texts in Mathematics, 1975.
  - A classical treatment of point-set topology, with a viewpoint on applications to analysis.
- *Counterexamples in Topology* by Lynn Steen, J. Arthur Seebach Jr., Springer-Verlag, 1978.
  - Many interesting examples of bizarre topological spaces.
- *Introduction to Topological Manifolds* by John Lee, Springer, 2011.
  - Another treatment of introductory algebraic topology. This was used as a main textbook in previous years.

Problem sets: Problem sets will be assigned weekly (except for Thanksgiving), and posted on Canvas by Friday. Solutions must be submitted to Gradescope by the Friday of the following week. Each student will have an allowance of seven late days, which can be used without prior permission from the instructor. Please be prudent with your use of late days, as no more extra days will be given. Collaboration with other students on the problem sets is allowed, though thinking about the problem sets on your own is the best way to understand the material. If you do discuss the problem set with others, please indicate clearly the names of the people with whom you collaborated, and write your solutions separately in your words while justifying all the claims and stating clearly all the previous results that you are using.

Midterm and Final exams: The midterm and final exams will be posted on Canvas, and the exact logistics will be announced later in the quarter. Collaboration with other students on the midterm and final exams is not allowed.

Grading scheme: Weekly problem sets (60%), midterm exam (20%) and final exam (20%). The lowest problem set grade will be dropped.

Course Schedule:

- Week 1 (9/29 - 10/3): Basics of topological spaces and continuous functions.
  Relevant reading material: Munkres Chapter 2.
- Week 2 (10/6 - 10/10): Product, metric, and quotient topology. Topological groups.
  Relevant reading material: Munkres Chapter 2.
  Problem Set 1 due on 10/10.
- Week 3 (10/13 - 10/17): Connectedness and compactness.
  Relevant reading material: Munkres Chapter 3.
  Problem Set 2 due on 10/17.
  10/17: Last day for adding courses and removing conditions and incompletes
- Week 4 (10/20 - 10/24): Countability and Separation axioms.
  Relevant reading material: Munkres Chapter 4.
  Problem Set 3 due on 10/24.

Below is a tentative schedule. I will likely go slower than outlined here. This is subject to change, and I am open to topic suggestions.

- Week 5 (10/27 - 10/31): Midterm review, Tychonoff theorem, Stone-Čech compactification.
  Relevant reading material: Munkres Chapter 5.
  10/29 - 11/4: Midterm examination period
- Week 6 (11/3 - 11/7): Metrization theorems, paracompactness.
  Relevant reading material: Munkres Chapter 6.
  Problem Set 4 due on 11/7.
- Week 7 (11/10 - 11/14): Complete metric spaces, function spaces, Baire category.
  Relevant reading material: Munkres Chapters 7 and 8.
  Problem Set 5 due on 11/14.
- Week 8 (11/17 - 11/21): Fundamental group
  Relevant reading material: Munkres Chapter 9.
  Problem Set 6 due on 11/21.
  11/19: Last day for dropping courses, exercising pass/fail option, and changing sections
  11/20-12/5: Registration for winter term 2025-26
- Week 9 (11/24 - 11/28): Separation in the plane, Seifert-van Kampen theorem.
  Relevant reading material: Munkres Chapters 10 and 11.
  No Problem Set due. Enjoy your Thanksgiving!
  11/27-11/28: Thanksgiving (Institute holiday)
- Week 10 (12/1 - 12/5): Classification of surfaces, covering spaces, applications to group theory.
  Relevant reading material: Munkres Chapters 12 to 14.
  Problem Set 7 due on 12/5.
  12/5: Last day of classes Last day to register for winter term 2025-26 without a $50 late fee
- Week 11 (12/8 - 12/12) No classes.
  12/6-12/9: Study period
  12/10-12/12: Final examinations for fall term 2025-26

(Last updated October 25, 2025)