Introduction to Homotopy Theory

eCHT Course Winter 2024

Basic Information:

Course title: Introduction to homotopy theory

Instructor: Jack Carlisle

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Term: Winter 2024

Meeting time: MWF 11:00am ET - 11:50am ET, starting on 01/17, and ending on 05/03. The week of 03/11 - 03/15 will be a break.

Course text: Hatcher's *Algebraic Topology*

Course Description and Prerequisites

This is an introductory course on homotopy theory. We will cover the majority of chapters 1 and 4 of Hatcher's *Algebraic Topology*. Time permitting, we will cover an assortment of advanced topics.

Students are expected to have a strong background in point-set topology (topological spaces, connectedness, compactness, products, quotient spaces, etc.) and abstract algebra (groups, rings, modules, etc.). Prior knowledge of smooth manifolds and algebraic topology is helpful, but not required.

Student Expectations

Each student is expected to participate fully in the course, just as if it were an in-person course at the student's home institution. Attendance at all live meetings is required, and active participation will sometimes be expected. Students are expected to spend additional time each week engaged with the course material on their own. A variety of formal assignments are due throughout the semester, including

- **Written homework:** Problem sets will be posted weekly and due at the start of class on Fridays (11 am ET). Both neatly handwritten (scanned to pdf) and typed solutions solutions will be accepted. Submission, feedback, and grading will take place on Gradescope.
- **Written exams:** There will be two exams. The first is a week long take home midterm, which will be due (DATE TBD). Unlike homework, the midterm is to be completed individually without consulting others. The second exam will be a 50 minute final, which will take place synchronously during class on 05/03.

- **Video project:** Create a short (3-5 minute) video explaining a topic covered (or perhaps just mentioned) in the first half of the course. A topic should be chosen by (DATE TBD), a draft outline of the mathematical content uploaded to Gradescope for feedback on (DATE TBD), and the video uploaded to Gradescope by (DATE TBD).
- **Writing project:** Write a 3 - 6 page expository paper on a topic directly related to the course. This expository write up should be readable by a peer learning the same material for the first time. Submit choice of topic by (DATE TBD), a written draft outline for feedback on (DATE TBD), and the final version submitted on (DATE TBD).

As a general rule, students are expected to obtain 2-3 independent study credits from their home universities for their participation in the course. This requirement is waived on an individual basis for students whose home universities do not have formal independent study opportunities. At the end of the course, a letter grade A/B/C/F will be reported to each student's home institution adviser.

Topics Covered

- Hatcher Chapter 1
  - Basic definitions
  - Fundamental groups
  - Covering spaces
  - Extra Topics: TBD ($K(G,1)$s)
- Hatcher Chapter 4
  - Higher homotopy groups
  - Methods of Calculation
  - Connections with cohomology
  - Extra Topics: TBD (Cohomology of fiber bundles, Brown Representability, Spectra and (co)homology theories)

Technology

Access to a computer with speaker, microphone, webcam, and a good internet connection. Access to a tablet is helpful for in class discussions and activities, but not required. Inexpensive plug-in tablets are readily available.

Grading

We will be using the eCHT Course Rubric. Letter grades (A, B, C, F) correspond to demonstrated understanding of the course material in the following way.

A - Full understanding of the mathematical content; technically correct written work with only minor errors; fully participated in the course activities; attended most or all of the meetings; contributed substantially to online discussions; submitted all required work.

B - Good understanding of the mathematical content; mostly correct written work; participated in the course activities with some absences; attended some of the meetings; contributed occasionally to online discussions; submitted most required work.

C - Incomplete understanding of the mathematical content; substantial errors in written work; participated only occasionally in the course activities; attended meetings rarely; contributed rarely to online discussions; submitted only part of the required work.

F - Little to no understanding of the mathematical content; fundamentally flawed written work; did not participate in the course activities; did not attend meetings; did not contribute to online discussions; did not submit any required work.

Your overall grade will be calculated as a weighted average of the following components:

Homework 20 %

Participation 25 %

Video Project 10 %

Writing Project 15 %

Midterm 15 %

Final 15 %

Feedback will be provided weekly on the homework (check plus/check/check minus), and following each assignment due date.

Extra Help

Do not hesitate to drop by during office hours (on Zoom) or make an appointment with either the instructor or teaching assistant to discuss a homework problem or any aspect of the course.

Attendance Policy

Attendance and participation is expected at every class meeting. Contribution to work in small groups during class directly contributes to grade. Email instructor for up to three excused absences.

Academic Honesty (*adapted from UC Berkeley's Center for Teaching and Learning*)

Homework and exams are presumed to be your own original work that has not previously been submitted for credit in another course unless you obtain prior written approval the instructor. You may use ideas by other individuals, but only with proper citation and correct attribution to the source (book, publication, web site, person, etc.).

Collaboration and Independence: Working on homework problems, reviewing lecture materials, and studying for exams with peers is encouraged. While discussing homework assignments with peers is encouraged, solutions must be written up individually and the names of everyone who discussed the problem together listed.

Cheating, Plagiarism, and Self-plagiarism: You are expected to write your own solutions and to provide full and accurate citations for any ideas from other sources, including any of your own previously or concurrently submitted course work. Cheating and failure to provide citations may result in a failing grade.