Syllabus: M532 Algebraic Topology - Fall 2019

Instructor:

Instructor: Eric Chesebro
Office: 308 Mathematical Sciences
Email: eric.chesebro@mso.umt.edu
Phone: x2687
Office hours: Tuesday at 11, Friday at 2, and by appointment. See also www.umt.edu/people/chesebro.

Course Overview

As are geometry and algebra, topology is a fundamental property (although more elusive) of the real and complex numbers. Like isometries and isomorphisms preserve geometric and algebraic properties respectively, maps called homeomorphisms relate spaces with identical topologies. As is often the case in these situations, the fundamental question of whether a pair of spaces is homeomorphic can be extremely difficult.

Algebraic topology and, in particular, homology can often help. Homeomorphic spaces should have identical homologies, so if it can be shown that a pair of spaces have distinct homologies then they cannot possibly be homeomorphic. Poincaré formalized the idea of homology for precisely this purpose. Euler's polyhedron formula, which he was unable to prove was an invariant, follows naturally from Poincaré's theory.

In this course we will learn the basic theory of homology. Along the way, we will encounter interesting topological spaces and study simplicial complexes, abelian groups, and commutative algebra. I am somewhat open and flexible with regard to the direction of the course. If you have suggestions, please share them.

One such possibility would be to learn a little about topological data analysis. Homology has recently become of interest to those studying large or complicated data sets, as it provides a new, intuitive, and computable invariant in many such settings.

Prerequisites

Students should have experience with linear algebra and be able to write careful mathematical proofs. Although a course in elementary topology would be useful, it is not required.
In the beginning of the course, we will review some elementary topology and some fundamentals about abelian groups.

Text

Algebraic Topology, by Allen Hatcher. This text can be downloaded for free through Professor Hatcher's website http://pi.math.cornell.edu/~hatcher/.
It is also possible to purchase a bound copy of this book.

Homework and expectations

Your grade will be based on a homework score. Assignments will be collected weekly. You are free to work together on your homework and to ask me questions, but your final write ups should be (neatly) written in your own words. Homework will be graded on completeness, correctness, and writing style.

If you have passed your comprehensive examination then you need only complete one problem per week.

You are expected to be an active participant in the course. You should speak up in class and try to answer questions as they come up.

Guidelines and policies

University dates and deadlines

You should be aware of the important dates and deadlines posted by the Registrar's Office.

Academic honesty

I take academic honesty very seriously and I will act on any transgressions that I notice. Misconduct is subject to an academic penalty in this course and/or a disciplinary sanction by the university. We all know that a record of academic misconduct is a very bad thing to have documented in your academic history.

All students should be familiar with the Student Conduct Code.

Disability modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406.243.2243. I will work with you and Disability Services to provide an appropriate modification.