

Math 654: Algebraic Topology I

Fall 2021

CB 335

MWF 11-11:50

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Many fundamental questions in topology are very difficult to answer. For example, it can be difficult to determine if two topological spaces are homeomorphic. The idea of algebraic topology is to transform these questions to questions in algebra that may be easier to answer. The slogan for this class is *topology is hard and algebra is easy*.

There are many ways to convert topology to algebra. In this class we will focus on homology and cohomology. The main topics for this semester are:

- Simplicial, singular, and cellular homology and cohomology,
- The Mayer-Vietoris sequence,
- The cup product,
- The Universal coefficients and Künneth theorems,
- Poincaré duality.

Prerequisites: The content of MA 551 and 651 will be assumed for this class. Compactness and continuity will be especially important. We will also make significant use of cell complexes, CW complexes and manifolds. (We will primarily work with these types of “nice” topological spaces.)

We will also use a lot of (homological) algebra. Specific familiarity with homological techniques is not assumed, but general comfort with algebra is.

Assessment: Assessment in this class will be based on student presentations.

Students will be provided with an outline of the topics to be discussed and each student will be assigned specific proofs to present. Proof assignments will be posted in the course outline. Students are free to exchange assignments and are **strongly** encouraged to consult the resources below and consult with each other to prepare for their presentations.

Presentations will be evaluated based on the rubric below. Grades will be based on proof presentations and overall engagement with the class.

3	You were prepared and well organized. If there were problems along the way, you were able to finish the proof with help from your classmates.
2	You were prepared, but it was hard to understand your solution. If there were problems along the way, it was difficult for your classmates to help you.
1	You had thought about the proof a little, but not enough to be prepared to present it well.
0	You were not prepared.

Final grades will be determined using the standard distribution.

Texts: The primary text for this class is

- *Algebraic Topology* by Hatcher <https://pi.math.cornell.edu/~hatcher/AT/AT.pdf>

If you are interested in additional references the following texts may be helpful:

- *Algebraic topology* by Edwin Spanier
- *Algebraic topology* by Tammo tom Dieck

- *Algebraic topology from a homotopical viewpoint* by Marcelo Aguilar, Samuel Gitler, and Carlos Prieto
- *Category theory in context* by Emily Riehl <https://math.jhu.edu/~eriehl/context.pdf>

Attendance: Class attendance is expected of all students.

Classroom Demeanor: Turn off all cell phones or other electronic devices prior to entering the classroom. An attitude of respect for and civility towards other students in the class and the instructor is expected at all times.

Academic Policy: For policy regarding attendance, accommodation due to disability, and nondiscrimination statement please see <https://www.uky.edu/universitysenate/acadpolicy>.

Academic Integrity: Please see <https://www.uky.edu/universitysenate/ao> for expectations for academic integrity.

Accommodations due to disability: If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multidisciplinary Science Building, Suite 407. You can reach them via phone at (859) 257-2754 and via email at drc@uky.edu. Their web address is <https://www.uky.edu/DisabilityResourceCenter/>.

Diversity, Equity, and Inclusion The University of Kentucky is committed to our core values of diversity and inclusion, mutual respect and human dignity, and a sense of community (Governing Regulations XIV <https://www.uky.edu/regs/gr14>). We acknowledge and respect the seen and unseen diverse identities and experiences of all members of the university community (<https://www.uky.edu/regs/gr14>). These identities include but are not limited to those based on race, ethnicity, gender identity and expressions, ideas and perspectives, religious and cultural beliefs, sexual orientation, national origin, age, ability, and socioeconomic status. We are committed to equity and justice and providing a learning and engaging community in which every member is engaged, heard, and valued.

We strive to rectify and change behavior that is inconsistent with our principles and commitment to creating a safe, equitable, and anti-racist environment. If students encounter such behavior in a course, they are encouraged to speak with the instructor of record or the colleges diversity officer (<https://www.uky.edu/inclusiveexcellence/college-diversity-inclusion-officers/>), who is charged with addressing concerns about diversity, equity, and inclusiveness. Students may also contact a faculty member within the department, program director, the director of undergraduate or graduate studies, the department chair, or the dean. To submit an official report of bias, hatred, racism, or identity-based violence, visit the Bias Incident Support Services website (<https://www.uky.edu/biss/report-bias-incident>).