Topological Data Analysis
M417 Section 01 (37346)
Spring 2025

Time: **12:30pm-1:45pm TR**	Room: **SEB 308**

Course Description: This course will focus on understanding some current research on geometry and topology pertaining to applications. Students will learn how to bring together the fundamentals of computational geometry, algebraic topology and data analysis to understand ways to visualize and process data. We plan to discuss around some of the following topics:

1. Introduction to metric spaces and some topological ideas
2. Triangulations and Simplicial Complexes
3. Simplicial Complexes on data sets
4. Topics from the following list:
   i) Euler Characteristic and Applications
   ii) Voronoi Diagrams, Delaunay Triangulations and applications
   iii) Persistent Homology and Applications to Data Analysis
   iv) Kernel Methods
   v) Discrete Morse Theory

Prerequisites: Permission from instructor

Co-requisites: There are no co-requisites

Learning Outcomes:

- Familiarity with metric spaces and some topological ideas
- Familiarity with basic algorithms for calculating clustering, Betti numbers, homology cycles, topological persistence, persistence barcodes
- Ability to use available software related to the topics discussed in class.
- Understanding applications in data analysis and machine learning
- Special topics - based on interest

Course Page: tda.mathematics.land

Textbooks: Suggested references will be given out in class

Instructor: Atish J Mitra (email: amitra@mtech.edu)

Office Hours (MUS 203): 11:00am-12:00pm TR, or by appointment. Please send me an email if you need to meet at any other specific time.

Attendance Policy: Regular attendance is strongly recommended.

Grading Policy: Grades will be based on attendance and participation (10%), a hourlong in-class exam (20%) and a project (70%). I do not grade on a curve, and do not assign individual extra credit assignments. Your grades will be independent of how the rest of the class performs.

Grading Scale:

	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
	93-	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	0-59

Academic integrity:

A zero-tolerance policy will be enforced for academic dishonesty / cheating. Academic dishonesty / cheating includes plagiarism on homework or other assignments (including copying solutions from the internet or using generative AI to create solutions), copying from or deliberately aiding another student during quizzes / exams, using unauthorized books, notes, calculators or other computing devices, using cell phones, pagers, Apple/Android watches or any other communicating devices during quizzes / exams.

Any student who is found to have cheated on a homework / quiz / exam will receive a penalty (at the discretion of the instructor) ranging from a 0 in that particular homework / quiz / exam to a grade of F in the course. Moreover, the incident of academic dishonesty will be reported to the office of the Provost/Vice Chancellor for Academic Affairs.

You should carefully read Montana Tech's academic dishonesty policies. It is available in the student handbook, which can be found following the link:
https://www.mtech.edu/student_life/student-handbook.pdf

The instructor reserves the right to assign seating arrangements or change a student's current seating arrangement before or during any quiz or exam.

Policy on Generative AI:

While you are encouraged to experiment with Generative AI, be aware that you are not allowed to use such resources for homework and take-home exams for this class. The reason for this policy for our class is that the use of generative AI for mathematics problems often produce incorrect solutions or solutions with incorrect reasoning, and therefore does not help in learning the material.

Miscellaneous Policies:

1. Check Canvas for announcements and other notes regularly. Canvas will be used in this course only to record your scores on quizzes or exams, and not to calculate the course grade. Course grade will be calculated at the end of the semester as per "grading policy" given above.

2. Please do not hold conversations, either with your classmates or through your cell phones, during the lecture. Cell phones/pagers must be put on silent at all times. No texting during class.

3. All unauthorized recordings of class are prohibited. Recordings that accommodate individual student needs must be approved in advance and may be used for personal use during the semester only.

4. It is your responsibility to check all your grades on Canvas before the final exam date and report me in writing if your grades are recorded incorrectly. You should keep all your graded exams/quizzes/classwork/homework until you receive your final course grade.

5. **ADA Accommodations:** Montana Tech provides reasonable accommodations to students with diagnosed disabilities. Contact Disability Services at (406) 496-4428 or by email at **sgoodell@mtech.edu** to discuss accommodations and obtain an Accommodation Letter. Once you receive your letter, please meet with the instructor to discuss your access needs. Operation Access is a cross-campus initiative dedicated to ensuring access to all of Montana Tech's digital content by providing support to faculty and staff who curate digital content. If you encounter an inaccessible webpage, link, or document anywhere on our web or course content, please **message the Instructor.** The Instructor will work together with Disabilities Services to make inaccessible content more accessible.

6. **Emergency Evacuation Procedure:** See university webpage and emails.