Math 462: Topology and Geometry for Data Analysis

TR 9:40–10:55am in Ayres 123. Office Hours in Ayres 204, TBD.

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Introduction.
Welcome to our class! The objective of this course is to give an introduction to the relatively new area of Computational Topology. We will learn to use tools (mostly) from the mathematical theory of Topology, and then we will implement them computationally for finding interesting structures within data sets.

The contents of the class will be split into two parts. In the first part of the class we will cover the basic concepts of point-set topology. For this we will use J.R. Munkres' book "Topology," 2nd Edition, from Prentice Hall. The second part of the course will be focused on algebraic-topology techniques and their implementation on data analysis. We will use materials from the book "Computational Topology" by H. Edelsbrunner and J.L. Harer, by the AMS.

Disclaimer.
I have put together a syllabus for the class (see below). But please be aware that since this is the first time this course is taught at UTK, this is an "experimental syllabus," so changes along the way may occur.

Evaluation.
The final grade you will receive in the class will depend on your homework grade (50%) and the grade you get in your final presentation (50%).

Date	Topic(s) and Homework	Section(s)
1/9	Overview, Introduction; Set theory and Logic homework: §1: 1-10, §2: 1-6, §5: 1-5. Read chapter.	Munkres Ch.1 §1-11
1/14	**No Class Today**	
1/16	Point-set topology: Definitions, Examples homework:	M Ch.2 §12-13
1/21	Product and Subspace Topologies homework:	M Ch.2 §15-16
1/23	Closed Sets and Limit Points homework:	M Ch.2 §17
1/28	Continuity homework:	M Ch.2 §18
1/30	Connectedness homework:	M Ch.3 §23-24
2/4	Compactness homework:	M Ch.3 §26-28
2/6	Compactness homework:	M Ch.3 §26-28

2/11	Quotient Topology	M Ch.2 §22
	homework:	
2/13	Simplicial Complexes	Edelsbrunner & Harer III.1
	homework:	
2/18	Convex Set Systems	E&H III.2
	homework:	
2/20	Point Cloud Triangulations	E&H III.3-III.4
	homework:	
2/25	Simplicial Homology: Definitions, Examples	E&H IV.1
	homework:	
2/27	Induced Maps	E&H IV.1
	homework:	
3/4	Singular Homology, Functoriality	*Handout*
	homework:	
3/6	Matrix Reduction Algorithm	E&H IV.2
	homework:	
3/11	Relative Homology	E&H IV.3
	homework:	
3/13	Exact Sequences	E&H IV.3-IV.4
	homework:	
3/18	**Spring Break**	
3/20	**Spring Break**	
3/25	Zig-zag Lemma	E&H IV.4
	homework:	
3/27	Persistent Homology: Intro	E&H VII.1
	homework:	
4/1	The Persistence Algorithm	E&H VII.1-VII.2
	homework:	
4/3	Morse Theory and Persistence	E&H VI.1, VI.3
	homework:	
4/8	Stability Theorems and Homology Inference	E&H VII.2
	homework:	
4/10	Gene Expression Data	E&H IX.1
	homework:	
4/15	Extended Persistence	E&H VII.3
	homework:	
4/17	Protein Docking and the Elevation Function	E&H IX.2
	homework:	
4/22	**Presentations**	
4/24	**Presentations**	