

Tentative Schedule of CSE 5559

Computational topology: Theory, algorithms and applications to data Analysis

- I. Basics in topology
 - I.1 Topological space
 - I.2 Maps, homeomorphisms, homotopy
 - I.3 Manifolds
- II. Complexes
 - II.1 Simplicial complexes
 - II.2 Commonly choices simplicial complex from point cloud data
- III. (Simplicial) Homology
 - III.1 Chains, cycles, boundaries, and homology groups
 - III.2 Matrix view, and algorithm to compute
- IV. Persistent homology
 - IV.1 Filtrations
 - IV.2 Persistent homology
 - IV.3 Matrix view and reduction-based algorithm
 - IV.4 Extensions and discussions
- V. Homology inference from Data
 - V.1 Set up
 - V.2 Persistent module and interleaving
 - V.3 Homology inference
- VI. Data Sparsification
 - VI.1 Sparsified Rips
 - VI.2 Graph induced complex
- VII. Analysis of functions on data
 - VII.1 Reeb graph and contour trees
 - VII.2 Consistency of hierarchical clustering
 - VII.3 Mapper and multiscale-mapper for complex maps
- VIII TBD: Issue of Noise or Discrete Morse theory

About reference or text-books for this course, given that computational topology is rather new, there are no ideal textbook for our course. There are some ref books on the course website. But mostly, I will provide most of the course notes.