Computational Topology

August 25, 2010

Instructors   The course will be co-taught by Dr. Paul Bendich and Professor Dr. Herbert Edelsbrunner.

Course description   This course is aimed at graduate students in mathematics and computer science, although other qualified students are also welcome to attend. The course will be an introduction to topology from a computational viewpoint. Topology is the study of the properties of spaces which remain invariant under continuous transformations. Historically, topology has been part of pure mathematics, but applied and computational topology have recently come to the forefront. The main goals and themes of this course are as follows:

- Understanding traditional methods of algebraic topology from a computational viewpoint. Simplicial complexes provide the basis for computing topological invariants, and there are a variety of algorithmic approaches to computing homology. Students will learn which are the most practical as they learn the topology.

- Learning the new theoretical methods including persistent homology and complexes built from point cloud data. Necessary algebraic background will be given as needed.

- Understanding and developing applications of topology to data. In some of the homework assignments, students will be able to experiment with several recently developed software packages.

Texts   The recently published textbook *Computational Topology: an introduction* by Edelsbrunner and Harer will be the main text. Other materials, including contemporary journal articles and conference publications, will be distributed as needed.