Math 412 Fall 2012

Instructor: Paul Bendich **Office:** 210 Physics Building
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Place: West Duke 08A **Time:** Tues/Thurs 10:05-11:20.

Textbooks:

- *Topology: A First Course*, by James R. Munkres
- *Computational Topology: an Introduction*, by Herbert Edelsbrunner and John Harer

Course Description: In loose terms, a topological space is a set together with a notion of "nearness", and a topological property is something which can be defined entirely in terms of this notion; such properties remain invariant under continuous deformations. The course begins with a discussion of some of these properties (such as connectedness and compactness), as well as an introduction to some basic and exotic topological spaces.

We then take an algebraic turn into homology, which associates a discrete set of algebraic invariants to a topological space; these invariants help us decide (in an algorithmic way) when two spaces should be considered topologically distinct.

We finish the course with a description of persistent homology, a tool used in the emerging field of topological data analysis. Algorithmic considerations will be discussed throughout the course, while applications will come up both in lecture and in student presentations.

Syllabus: posted online at www.paulbendich.com/412fall2002.html

Assignments: There will be problem sets, which will be graded and collected. I will probably post problems after each lecture, and then collect the problems in batches every Tuesday.

Presentations: During the last two class periods and the final-exam period, each student will prepare and give a 30-minute presentation/lecture. I'll put some suggested topics (some theoretical, some application-based, some a mixture) on the website, and students can select one of those or discuss the choice of a different one with me. In most cases, preparation for the lecture will consist of reading one or more journal articles and/or textbook sections, and then synthesizing and presenting the material to the other students.

You will be graded on presentation quality as well as on understanding of the material, so I strongly suggest going over the presentations with me in the weeks before your lecture.

Grading: Your grade will be determined by your lecture quality and your performance on the weekly problem sets. Although I permit (and encourage) you to work collaboratively on the latter, your written submissions must be entirely your own work.