Math 427/527 Algebraic Topology

Instructor: Jim Bryan.

What is algebraic topology? Broadly speaking, algebraic topology associates algebraic objects (such as groups or rings) to topological spaces. It allows one to use algebraic methods to study topological spaces, and occasionally it allows one to study algebraic objects with topological methods. The subject cleaves into two broad channels of homotopy theory and homology theory. In this course we will primarily focus on homology (and cohomology). Homological ideas also show up in a wide variety of modern mathematics including algebraic geometry, representation theory, algebra, and more. Understanding homology in the topological context will serve you well, even if you are primarily interested in other geometric or algebraic topics.

Texts: The main texts are *Algebraic Topology* by Allen Hatcher and *Topology and Geometry* by Glen Bredon. Neither is required, although I think both are worth having on your shelf. Hatcher's book is available for free on his website and is pedagogically excellent. He sticks to rather traditional topics in algebraic topology and I will follow his exposition when we cover those topics. Bredon has a broader and more modern choice of topics and is very good for a general reference although I will often present said topics differently from him.

Course Outline: This is a graduate course in algebraic topology and the main goal of the course is to give a thorough introduction to homology and cohomology, including cup product, Poincare duality, Euler characteristic, and applications. It is cross-listed with the advanced undergraduate course, but for all intents and purposes, the two courses will be treated the same. Math 426 (introduction to topology) is listed as a formal prerequisite, but I do not consider it a logical necessity. I will introduce all the concepts

from scratch, but I will assume that you have a fair amount of mathematical maturity — that which I would expect from a typical advanced honors undergraduate math student or beginning graduate student at UBC. You may be expected to read up on some of the more basic ideas on your own.

Course grades: The grades in this course will be based on homework (due either weekly or once every two weeks) and on take home exams (probably one midterm and one final). Depending on the size and interests of the class, we may replace the final take home exam with individual projects/presentations.