

## SYLLABUS FOR 603D: HOMOTOPY THEORY, CLASSIFYING SPACES AND GROUP COHOMOLOGY

### 1. CONTACT INFORMATION

The instructor for this course is me, Ben Williams. I may be reached at [tbjw@math.ubc.ca](mailto:tbjw@math.ubc.ca).

The course website is <http://www.math.ubc.ca/~tbjw/ClassifyingSpaces/index.html>. What appears in this document is much the same as what appears on the website, and the website is more up-to-date. Please consult the website in case of any changes.

### 2. REFERENCES

There is no single textbook for this class. Various references will be provided for selected topics over the course of the term.

### 3. DESCRIPTION

This is a topics course in the homotopy theory of classifying spaces of groups, and related aspects of homotopy theory. We have three principal aims: first, to explain how (algebraic) group cohomology for discrete groups can be viewed a special case of a homotopy-theoretic study of classifying spaces; second, to give an introduction to the theory of  $G$  bundles and characteristic classes; and third, to establish computational tools which are more generally applicable.

A first course in algebraic topology (such as Math 527) will be assumed, as will familiarity with undergraduate algebra.

### 4. HOMEWORK & GRADES

A number of homework exercises will be handed out over the course of the term. These will form the basis of the final grade for anyone registered in this course.

### 5. OUTLINE

Here follows an overambitious list of topics.

- (1) Locally trivial fibrations
- (2) Classifying spaces and universal bundles
- (3) Fibrations
- (4) Spectral sequences
  - Constructions
  - The Serre (Leray–Serre) spectral sequence

- The Eilenberg–Moore spectral sequence
  - The Fibre-to-base Eilenberg–Moore spectral sequence
- (5) Characteristic classes
  - (6) Sheaf cohomology
  - (7) Cohomology operations
  - (8) The extra-special 2-groups [time permitting]
  - (9) Vector fields on spheres [time permitting]