math-423-502

Representation Theory of Finite Groups and Homological Algebra

This course is Math 423/502 and consists of two parts:

- **Representation Theory of Finite Groups.** A representation of a finite group is an embedding of the group into a matrix group. Representations arise naturally, for example, when studying the set of symmetries of a geometric or combinatorial object. Representations can be uniquely decomposed into irreducible representations; we will classify the irreducible representations of a group. Using the theory of characters we will learn how to effectively decompose an arbitrary representation into its irreducible constituents.

- **Homological algebra**. Homology and cohomology arise in a variety of subjects across pure mathematics and they are essential in algebraic topology, algebra, and algebraic geometry. We will study homological algebraic in the setting of modules over a commutative ring which is broad enough to encompass most applications. In this context, we will see how a complex and its cohomology naturally arises when studying a module via it generators, the relations among the generators, the relations among the relations, and so on.

Grades will be based on two midterm (in class) exams, one on representation theory, one on homological algebra. Dates of the midterms to be announced. Weekly homework will be assigned but not graded — however, the problems on the exams will be a subset of the homework problems.