Math 697: Heegaard Floer homology
Fall 2023

Time. Tuesdays and Thursdays at 2:30pm-4pm

Location. East Hall 2866

Instructor. Linh Truong (tlinh@umich.edu, office: East Hall 4842)

Office hours. Mondays 10:30am-12pm or by appointment

Course website. http://www-personal.umich.edu/~tlinh/winter21/topics697.html

Course Description. The heart of low-dimensional topology is the study of three-manifolds and four-manifolds. Constructions of three-manifolds include taking the complement of a knot, performing Dehn surgery along a knot, or forming a covering space branched along a knot, while four-manifolds can be described by Kirby diagrams involving knots. Thus knot theory is intimately connected to three-dimensional and four-dimensional topology. This course will present modern invariants of low-dimensional manifolds and knots that arise from symplectic geometry or combinatorial methods.

Since its introduction in the late 1980s, Floer homology has become one of the most important tools in symplectic and low-dimensional topology. This course will introduce a version of Floer homology called Heegaard Floer homology, an invariant for knots, three-manifolds, and four-manifolds. The course will begin with background on Morse theory, symplectic geometry, and Heegaard diagrams. We will then define Heegaard Floer homology and compute examples. As applications we may discuss minimal genus problems, detecting exotic smooth structures on four-manifolds and finding topological properties of knots. Topics will be chosen according to class interests.

Prerequisites. This course will assume a basic understanding of smooth manifolds (smooth maps, derivatives, differential forms) and algebraic topology (homology, cohomology).

Textbook. There is no textbook for this class. References will be available on the website.

Grading Policy. Based on homework (50%) and the final project (50%).

Homework. I will post problem sets to the course website.

Final Project. The final project is a choice of a paper or 40-minute in-class presentation. The final paper is an exposition on a topic related to the course and should:

- be 2 to 10 pages in length;
- be written in latex and submitted as a pdf;
- be emailed to me by Friday, December 1 at 8pm.

Suggested topics will be made available during the semester. For either the paper or presentation, the proposed topic should be emailed to me for approval by October 31.