Math 965: Toric Varieties.
Winter 2026

Lectures

Lectures will be held Mondays and Wednesdays 12-1:20pm (tentatively).

Course description

Toric varieties are a family of algebraic varieties that are closely related to the combinatorics of polytopes and cones. Many features of algebraic varieties that are very difficult to compute in general can be computed for toric varieties using this relationship. Even though toric varieties are very special, they are also ubiquitous with applications in many areas of mathematics, and are a great way to get comfortable and develop intuition with abstract concepts from algebraic geometry.

There are several different perspectives on toric varieties, each which have advantages. We will start the course by constructing toric varieties in different ways: via monomial maps, via geometric invariant theory, and via fans. After that, we will study the geometry of toric varieties. Some of the topics we will cover (time permitting) are the following: properties of toric varieties, toric morphisms, line bundles, moment maps, Cartier and Weil divisors, cohomology, the coordinate ring, variation of GIT and the secondary fan, resolutions, toric orbifolds, and toric degenerations.

Prerequisites: Students should be familiar with basic algebraic geometry (Spec and Proj, line bundles, divisors, vector bundles).

Textbooks

There are no required textbooks for this course. Recommended texts are:

- Fulton's *Introduction to Toric Varieties*

- *Toric varieties* by Cox–Little–Schenck

- Frank Sottile's *Ibadan Lectures on Toric varieties*