

Jan. 28, Steven Sam, UC Berkeley
Semigroups and affine toric varieties

Abstract: This is part of a learning seminar on toric varieties. A variety X is a toric variety if there is a dense open embedding $T \subset X$ of an algebraic torus together with an action of T on X that extends the natural action of T on itself. This week, we introduce semigroup algebras and define the category of affine toric varieties. We show that it is dually equivalent to the category of finitely generated, integral semigroups. We also examine subvarieties and nonsingularity.

Feb. 4, Matthias Beck, San Francisco State University
Elements of convex geometry

Abstract: I will discuss Chapter 2 of Mustață's lecture notes on toric varieties, so this talk will be a crash course in polyhedral geometry.

Feb. 11, Daniel Robertz, RWTH Aachen
Fans and Toric Varieties

Abstract: This talk is based on Chapter 4 of Mustață's lecture notes on toric varieties. The notion of affine toric variety introduced earlier is generalized to the notion of toric variety given by a fan in a lattice. Orbits of torus actions, toric morphisms, and a construction of toric varieties from polytopes are discussed.

Feb. 25, David Eisenbud, UC Berkeley
Toric Varieties, Rings of Invariants, and the Cohen–Macaulay Property

Abstract: I'll explain why normal affine toric varieties (aka the rings associated with saturated semigroups in \mathbf{N}^d) are Cohen–Macaulay. I'll also explain the connection with invariants of reductive groups, and, if time permits, present the Hochster–Huneke proof (as excerpted by Knop) of the Cohen–Macaulay property of rings of invariants under linearly reductive groups.

March 3, Dustin Cartwright, UC Berkeley
Some Examples of Toric Varieties

Abstract: I will begin by recalling the construction of toric varieties and toric morphisms in terms of fans. We will then look at a series of examples, including weighted projective space, blowups of toric varieties, and a proper non-projective 3-fold. In the second half, I will present an analysis of smooth toric surfaces. I will loosely follow parts of Chapter 4 of Mustață and section 2.5 of Fulton.

Mar. 10, Mauricio Velasco, UC Berkeley
Resolution of singularities

Abstract: In this talk I will give a combinatorial construction of an equivariant resolution of singularities for toric varieties. I will study in detail the case of surfaces and in particular characterize complete nonsingular toric surfaces as those which can be obtained from \mathbf{P}^2 or the Hirzebruch surfaces by a sequence of blow-ups at torus invariant points.

Mar. 17, Dustin Cartwright, UC Berkeley
Toric varieties as quotients

Abstract: In the first hour, I will discuss the construction of affine toric varieties as quotients, following the corresponding section of Chapter 3 in Mustață's notes. In the second hour, maybe we'll discuss some problems from Mustață or Fulton.

Mar. 31, Anthony Várilly, UC Berkeley
Divisors and line bundles on Toric varieties I

Abstract: This is the first talk of a three-part series on divisors, Picard groups and cohomology of line bundles on Toric varieties.

Apr. 7, Daniel Erman, UC Berkeley
Divisors and line bundles on toric varieties II

Abstract: This is the second talk of a three-part series on divisors, Picard groups, and cohomology of line

bundles on toric varieties.

Apr. 14, Daniel Erman and Anthony Várilly, UC Berkeley

Toric Fano Varieties and Computing Cohomology

Abstract: First we'll apply the ideas from the previous week's lectures by exploring the case of Toric Fano surfaces. Then we'll discuss how to compute sheaf cohomology on a toric variety. This lecture will cover the end of Mustață's Lecture 6 and all Mustață's Lecture 7.

Apr. 21, Martin Olsson, UC Berkeley

Degenerations of toric varieties

Abstract: I will discuss how to construct degenerations of toric varieties, and its connection with compactifications of certain moduli spaces. Time permitting, I will also discuss how this naturally leads one to consider logarithmic structures in the sense of Fontaine and Illusie (to fully understand this part it might be a good idea to browse through the first three sections of the reference: K. Kato, 'Logarithmic structures of Fontaine and Illusie').

Apr. 28, Jenia Tevelev, University of Massachusetts, Amherst

Compactifications of Subvarieties of Tori in Toric Varieties

Abstract: Closed subvarieties of algebraic tori have many unexpected geometric properties that makes them similar to subvarieties of Abelian varieties. For example, they (almost) are their own logcanonical models as conjectured by Miles Reid. One can study them using a combination of Mori theory and tropical geometry. A typical question that one should ask (and I would answer) is how to find a toric variety in which the closure of a given (non-toric!) subvariety is most well-behaved.

Apr. 29, Sam Payne, Stanford University

Current topics in toric geometry

Abstract: I will discuss some current research topics in toric geometry – with a focus on toric vector bundles, adjunction theory, and open problems.

May 5, Mircea Mustață, University of Michigan

Positivity properties of toric vector bundles

Abstract: Positivity properties of line bundles on toric varieties are well-understood. The picture gets trickier in higher rank, even if we restrict ourselves to equivariant vector bundles. On the other hand, certain vector bundles appear naturally in the study of line bundles, and it would be desirable to have a better understanding of the properties of these concrete vector bundles. I will discuss joint work with Milena Hering and Sam Payne describing positivity properties in higher rank.