MAT 598: Algebraic Geometry and Toric Varieties

Fall 2023

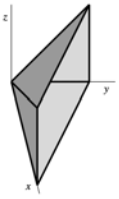
Instructor: Jonathan Montaño

School of Mathematical and Statistical Sciences, Arizona State University, Tempe

Days, Time, and Room : Tuesday - Thursday, 3:00 PM - 4:15 PM, WXLR 104.

Course description: Algebraic geometry is the study of solutions of polynomial equations (algebraic varieties) and the functions defined on them (regular functions). Toric varieties are a particular class of varieties with rich combinatorial information that makes them a great source of examples and testing cases of general theorems. According to W. Fulton: *"Toric varieties provide a way to 'see' many examples and phenomena in algebraic geometry."*

$V_\sigma \cong V(xy - zw) \subset \mathbb{A}^4_{\mathbb{C}}$



The first half of this course will be an introduction to the basic concepts in algebraic geometry such as affine, projective, and abstract varieties. In the second half of the course we will focus on toric varieties. No background beyond linear algebra and abstract algebra (groups, rings, and fields) is assumed for this course.

Main references: No specific textbook will be followed. However, much of the information will come from the following references:

- *A Concise Introduction to Algebraic Varieties*, B. Osserman, Graduate Studies in Mathematics, Vol. 216, AMS, 2021.
- *Lectures on Toric Varities*, D.A. Cox, 2005. Available at: https://dacox.people.amherst.edu/lectures/coxcimpa.pdf

Other references:

- *Toric Varierties* D.A. Cox, J. Little, and H. Schenck, Graduate Studies in Mathematics, Vol. 124, AMS, 2011.
- *Introduction to Toric Varieties*, W. Fulton, Annals of Mathematics Studies, Vol. 131, Princeton, 1993.
- *Algebraic Geometry*, R. Hartshorne, Graduate Texts in Mathematics, Vol. 52. Springer, 1977.
- *Introduction to Algebraic Geometry*, S.D. Cutkosky, Graduate Studies in Mathematics, Vol. 188, AMS, 2018

Prerequisites: Familiarity with linear algebra and abstract algebra (groups, rings, and fields).

Homework: Throughout the semester I will post assignments but they will not be collected. Students will be encourged to present solutions in class.

Grading: 50% of the grade will be based on participation (such as presentating solutions to homework problems). The other 50% will be based on a class project.