Department of Mathematics and Statistics

Colloquium Series

An Introduction to Computational Complexity in Algebraic Geometry

Lily Silverstein

Cal Poly Pomona

Abstract: Algebraic geometry studies sets of solutions to systems of multivariable polynomial equations. In computational algebraic geometry, the emphasis is on algorithms for finding or describing the solutions of particular systems, many of which come from science and engineering. Fundamental questions we might ask include: Does the given system have no solutions, finitely many solutions, or a positive-dimensional space of solutions? Can we eliminate any of the variables? Is one of the polynomials a linear combination (with polynomial coefficients) of the others?

Unfortunately, while algorithms theoretically exist for solving each of these problems, in practice the computations are often intractable for systems with more than a few variables. This is in sharp contrast to linear algebra (the special case of multivariable polynomials of degree one), where we have efficient, general algorithms that handle systems with thousands and thousands of variables.

In this talk, we'll explore in detail why nonlinear algebra is so much "harder" than linear algebra, and make the idea of "harder" precise using some key concepts from computational complexity theory. We'll also survey some different facets of current research in computational algebraic geometry.

Keywords: algebra, computational complexity, algebraic geometry, polynomials

Wednesday November 13th, 1:05 - 1:50pm in 4-1-314