COMPUTATIONAL COMMUTATIVE ALGEBRA
MTH 493/593 SPRING 2020

Instructor: Federico Galetto
E-mail: f.galetto@csuohio.edu
Office: RT 1528
Schedule: Spring 2020, Tuesdays and Thursdays 16:00-17:50

What is Computational Commutative Algebra? Polynomial functions and polynomial equations are very common in mathematics. One of the objectives of Commutative Algebra is to study the properties of systems of polynomial equations and their solutions. The Computational aspect comes from developing algorithms that allow to answer many problems about systems of polynomial equations using computers. Problems of interest include:

- Finding solutions symbolically (as opposed to approximating solutions numerically);
- Eliminating variables (find Cartesian equations for a rational parametric curve/surface);
- Ideal membership problem (can a polynomial be written as a linear combination of a given set of polynomials?).

Course objectives. In order to address the questions above, we will explore the algebra of multi-variable polynomials and develop the fundamental concept of Gröbner basis. This is a special collection of polynomials with particularly convenient properties from a computational perspective. In order to find Gröbner bases, we will study monomial orders, monomial ideals, and the Buchberger algorithm. Participants will also be introduced to the basics of algebraic geometry, namely the study of geometric objects defined by algebraic equations. Further topics will be explored in student projects.

Prerequisites. A grade of C or better in MTH 288 and MTH 358, or permission of the instructor. A willingness to work with abstract mathematics and proofs. Familiarity with basic computer programming will be helpful.

Textbook. (tentatively) Cox, Little, O'Shea, *Ideals, Varieties, and Algorithms*, 3rd edition, Springer.

TL;DR. Sign up if you like algebra and algorithms, and are not scared of proofs.

For more information visit https://math.galetto.org/cca or scan the QR-code.