Math 216A. Algebraic Geometry

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Textbooks: Algebraic Geometry (Hartshorne), Commutative Ring Theory (Matsumura)
Meeting time: 1:30–2:30 on Fridays

Algebraic geometry was classically concerned with the geometric study of solutions to polynomial equations in several variables over **C**. In its modern reformulation based on the concept of a scheme, the subject has acquired awesome technical power and its techniques not only permit a better arsenal with which to study classical problems over *any* field (not just **C**), but also have a vast range of applicability beyond the classical concerns: algebraic methods for studying analytic concepts (modular forms, analytic spaces, etc.), a geometric foundation that allows one to "visualize" commutative algebra and number theory, a source of important constructions and techniques in representation theory, a common framework in which one can view Galois theory and fundamental groups as "the same thing", and so on ad infinitum.

The course will cover much of Chapters 2 and 3 of Hartshorne, and some extra topics as time permits. It is *EXTREMELY IMPORTANT* to do the homework! It is only by working on most of the exercises in Chapter 2 and 3 that one can really understand things. If you have time, we strongly encourage you to try to work on as many exercises as possible, not just the ones which are assigned.

In order to cover a reasonable amount of material, we will have to assume you have been exposed to commutative algebra at the level of the book by Atiyah–MacDonald. The first 15 sections of the Matsumura text constitute a more sophisticated perspective on the same material, emphasizing some technical issues (like flatness) which are not so prominent in Atiyah–MacDonald.

You should gradually read the first 15 sections of Matsumura as the fall term progresses. We'll need Matsumura's text more seriously later on. Beware that Hartshorne's references to Matsumura are to a *different* book of his ("Commutative Algebra"), but our Matsumura text contains all the relevant proofs too. Some commutative algebra facts may just be stated clearly with reference to Matsumura for a proof, to save time.

It is permissable (and even encouraged) for students to discuss the exercises with each other, but please write up proofs in your own words.

The fall will cover around half of Chapter 2 along with several key topics that are not in the textbook. In the winter we'll wrap up Chapter 2 (skipping §9 on formal schemes whose real substance is treated elsewhere, such as in the book "FGA Explained") and move into sheaf cohomology in Chapter 3.