Math 259X: Moduli Spaces in Algebraic Geometry

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E-mail: `bejleri@math.harvard.edu` Class Hours: M/W 12-1:15pm
Office Hours: M 2-3, W 11-12 (or by appointment) Class Room: Science Center 310
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Course Description

The existence and construction of moduli spaces parametrizing geometric objects is a central problem in algebraic geometry. We will study the various tools and techniques used to address this problem, as well as applications.

Course Website

http://math.harvard.edu/~bejleri/teaching/math259xfa19/

Text

There will be course notes posted regularly on the course websites. The following texts, among others, may also be useful:

- Fantechi, et al., *Fundamental Algebraic Geometry*. AMS, 2005.

- Nakajima, *Lectures on Hilbert Schemes of Points*. AMS, 1999.

- Harris and Morrison, *Moduli of Curves*. Springer-Verlag, 1998.

- Farkas and Morrison, eds., *Handbook of Moduli*. International Press, 2013.

- Kollár, *Families of Varieties of General Type*. Manuscript available on authors website.

Prerequisites

Algebraic geometry at the level of a first year graduate course (e.g. chapters 2 and 3 of Hartshorne's *Algebraic Geometry*). Some algebraic topology and commutative algebra will also be useful. Please see me if you are not sure you have the needed background.

Homework and Grades

Undergraduate students and graduate students who have not passed their Quals require a grade. The grade will be based off of homework as well as a final presentation *or* final paper.

Homework will be assigned periodically during lectures and posted on the course website every other week. It will be due one week after being posted. Students are encouraged to work together.

Tentative outline

1. Preliminaries.
   Projective space and grassmannians, flat families, moduli functors and universal families, Hilbert schemes in general.

2. Hilbert schemes of points on curves and surfaces.
   Infinitessimal properties, compactified Jacobians and the Abel-Jacobi map, topological invariants, the McKay Correspondence, the Beauville-Yau-Zaslow formula.

3. Moduli of curves.
   Construction, algebraic stacks, Deligne-Mumford-Knudsen-Hassett compactifications, de Jong's alterations.

4. Moduli of higher dimensional varieties.
   Quasi-projective moduli of polarized varieties, KSBA theory of stable pairs compactifications.