

## ABELIAN VARIETIES (MATH 731)

BHARGAV BHATT

**Goal.** The goal of the first half of this class is to introduce and study the basic structure theory of abelian varieties, as covered in (say) Mumford's book. In the second half of the course, we shall discuss derived categories and the Fourier-Mukai transform, and give some geometric applications.

**Prerequisites.** I will use the language of schemes and cohomology (at the level of Hartshorne's book).

**Homework.** Some background material will be delegated to homework in the form of readings; I will also occasionally assign exercises in class.

**Grades.** Grades in this class will be based on participation and a final project<sup>1</sup>. The final project should be:

- an expository paper that is submitted by the exam date (noon on December 20),
- approximately 10-15 pages in length,
- on a subject related to abelian varieties,
- written in latex and submitted electronically as a pdf, and
- should read like a research paper (as opposed to rough notes).

I will be happy to discuss suggestions for topics halfway through the semester.

**References.** There is no required reference. Our main reference for the first part of the course is:

- (1) Mumford's *Abelian varieties*. We shall attempt to cover most of the "algebraic theory" in this book, occasionally with a slightly more modern perspective.

This material is also covered in the following more modern sources:

- (2) Van der Geer and Moonen's *Abelian varieties* book.
- (3) Milne's *Abelian varieties* notes.
- (4) Conrad's *Abelian varieties* notes.

The following sources cover some background material

- (5) Bosch, Lütkebohmert, and Raynaud's *Neron models* book. Chapter 2 in this book is a great place to learn about the basics of étale, unramified, flat, and smooth morphisms. Please teach this to yourself as soon as possible.
- (6) Illusie's *Grothendieck's FGA explained*. This paper contains an exposition of the theory of formal schemes and Grothendieck's formal existence theorem that I have found very worthwhile. I encourage you to look through this if you are unfamiliar with formal schemes and their uses.

References for the derived category story will be distributed later.

**Time and location.** Tuesdays and Thursdays from 11:30am to 1:00pm in 2866 EH

**Office hours.** TBA

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*Date:* Fall 2017.

<sup>1</sup>If you are a "Candidate", then you need not submit the final project.