MATH 221 LOGISTICS
HARVARD UNIVERSITY MATH DEPARTMENT, FALL 2017

Location: Science Center 310
E-mail: hirolee@math.harvard.edu
Class Meeting Time: M., W., F., at noon
What you should call me: Hiro

Course Content

This is a graduate-level algebra course. We'll start with the representation theory of finite groups, then do some basic ring theory, and then do representations of Lie groups. We will in particular cover the topics required of the Harvard algebra qualifying exam for graduate students, which can be found here:

`http://math.harvard.edu/quals/index.html`

Prerequisites: I will assume you have completed an undergraduate algebra sequence. So I'll assume basic familiarity with groups and rings.

Office hours and Course Assistants

Hiro's Office: Science Center 341 (in the back of the Birkhoff Math Library)
Office Hours: Tuesdays, 1 PM - 2:30 PM and 4 PM - 5:30 PM.

These are times I will be in my office. I set them aside to have time to interact with you—to help, to expand, to deepen your experience in the class. Because I am by the library, my door will often be closed. But knock, and I will answer!

Examinations

The Final Exam will be a take-home exam due Mon, December 18.

Collaboration and plagiarism policy

I strongly encourage all of you to collaborate. Please do so. If you do, you must indicate clearly on every assignment that you have collaborated, and indicate with whom. However, *write* solutions on your own. It is fine to think through problems and find solutions with each other, but **when it comes to the act of writing it all up, you must do so without assistance from another**. This is because the act of solving something and writing a mathematical proof are two different skills, and I want you to also hone the latter. As an extreme anti-example, copying and pasting solutions/proofs will not be tolerated. To reiterate, you may not *write* solutions together.

Finally, note that asking for a solution on Stackexchange, Quora, or Yahoo Answers is *not* considered collaboration in this class; it will be considered something very close to

cheating. I strongly discourage you from handing in any solution obtained by searching through, or asking on, a website like the ones listed above.

Grading

We will use three metrics/components to determine your grade in this class. They are:

(1) Homework (typically once a week, due Wednesdays)
(2) Make-up
(3) Final Exam.

The **Make-up** component may not be a typical component for other classes, so I will explain this. You will most likely submit incorrect homework or exam solutions at some point. For particular problems, you **are strongly encouraged** to come to an office hours (or make an appointment, with either me or the CA's) at some point to explain what the correct solution. This must be done less than one week after the return of the homework assignment.

Resources

For representation theory, see Serre's books, and Fulton and Harris's book. For ring theory, see Atiyah-MacDonald or Eisenbud's Commutative Algebra (with a view toward algebraic geometry). Also see Dummit and Foote.

Topics covered

(Not necessarily in this order; many topics will interplay and overlap. Also, depending on time, some topics may not be covered.)

Basic Commutative algebra. Noetherian rings and modules, Hilbert basis theorem, Cayley-Hamilton theorem, integral dependence, Galois theory, Noether normalization, the Nullstellensatz, localization, primary decomposition.

Representation theory of finite groups. Projection formulas, representation ring, class functions and the inner product; multilinear algebra, representation theory of the symmetric group.

Lie groups and Lie algebras. Introduction to Lie groups and Lie algebras: definitions, the exponential maps, semi-simple Lie algebras. The virtues of semisimplicity, sl_2, sl_3, Lie algebras in low dimensions, Cartan subalgebras, Roots, weights, Peter-Weyl theorem, unitary trick, Weyl character formula.