MATH 122 LOGISTICS
HARVARD UNIVERSITY MATH DEPARTMENT, FALL 2017

Location: Science Center 507
E-mail: hirolee@math.harvard.edu
Class Meeting Time: M., W., F., at 2 PM
What you should call me: Hiro

Course Content

This course is an introduction to groups and rings, which are foundational concepts in modern mathematics. Along the way, we will also deepen our understanding of linear algebra and the role of structures on vector spaces.

Prerequisites: I will assume you are all familiar with vector spaces, linear transformations, and matrices. Basic familiarity with mathematical proof is necessary; I recommend that you have taken at least one proof-based class before.

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

There will be a take-home exam from Mon, Oct 2 to Wed, October 11. There will also be an in-class exam on Fri, November 10. The Final Exam will be a take-home exam due Thursday, December 14.

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 five metrics/components to determine your grade in this class. The five components are:

(1) Homework (typically once a week, due Wednesdays)
(2) Make-up
(3) Midterm 1
(4) Midterm 2
(5) 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

We will not use a textbook in this class, though Artin's Algebra is a great resource. Notes will be posted on the course website after lectures, and there are several online sources you can use to cross-reference:

(1) Judson's free text: `http://abstract.ups.edu/download.html`
(2) Milne's various notes: `http://www.jmilne.org/math/CourseNotes/index.html`
(3) Beachy's various notes: `http://www.math.niu.edu/~beachy/`
(4) Conrad's notes on various topics: `http://www.math.uconn.edu/~kconrad/blurbs/`
(5) Dick Gross's lectures: `http://www.extension.harvard.edu/open-learning-initiative/abstract-algebra`

Other common texts include Dummit and Foote, and Lang's Undergraduate Algebra. These, however, are not legally available for free.

Topics covered

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

Group theory. (Sub)groups, actions, orbits, counting formulae. Equivalence relations, normality, quotients. Extensions (short exact sequences), finite groups, Cayley's Theorem, Cauchy's Theorem, Sylow's Theorems, simplicity, Thompson's Fields Medal. Klein 4 group, symmetric groups, alternating groups, linear groups for different fields, automorphism groups, groups coming from geometry. More examples.

Rings and modules. Rings, modules, ideals, quotients, units, principal ideal domains, classification of finitely generated modules over principal ideal domains, finite fields, characteristic, polynomial rings and their quotients.

More linear algebra. Finite fields, bilinear forms, tensor products.