MATH 3203 Number Theory (Fall 2022)

Professor John Bergdall
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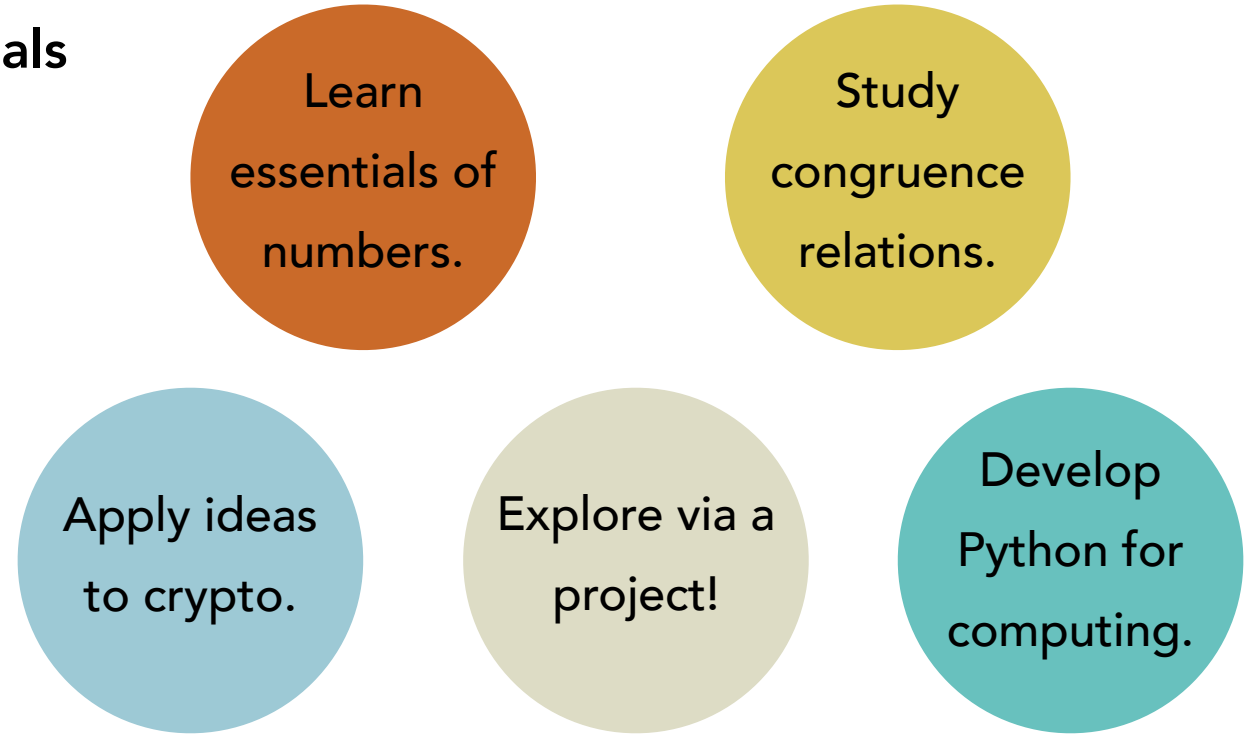
MWF 2:00 - 2:50 PM
KIMP 407

Overview

This foundational course on numbers focuses on structure and applications. How are numbers atomically built? How do special numbers distribute themselves? Does reorganizing numbers create useful perspectives for solving problems? How are numbers related to secret codes?

Learning goals



Page background: derived from mathforlove.com.

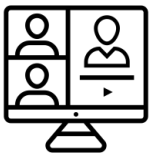
Materials

Textbook

A friendly introduction to number theory (4th ed.)
by Silverman
(Rent/buy: $58/$88*)

Course materials

Python programming and Jupyter notebooks.
cocalc.com
($14*)



Discussions, meetings, etc.

Course reading materials and discussion forums
learn.uark.edu
(Free)

*Used costs. If costs cause hardship or would limit your course access, email me for support.

Course breakdown

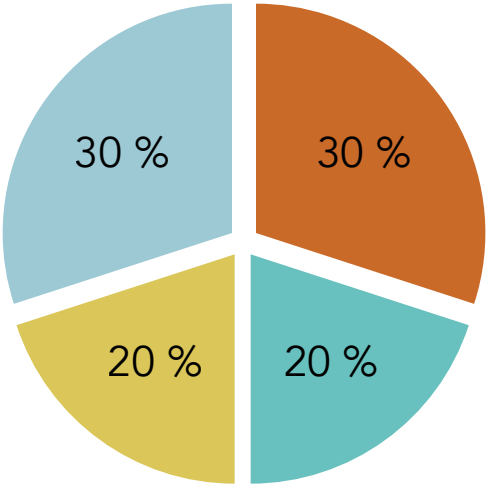
Students process on their own time. They engage problem solving alone and with peers. We assessment both skills and theoretical development. A final project completes the learning arc. (*Details on pg. 5-6.*)

Process

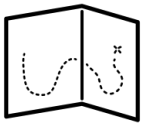
Assigned readings.
Python tutorials.
Supplementary videos.
Per week ≈ 4+ hrs.

Engage

Solve problems for class.
Experiment with Python.
Contextual assignments.
Per week ≈ 6+ hrs.



Four components count towards final marks



Group Project

Prepare a report.
Present your findings.
Use the text or other material.
Milestones throughout course.

Assess

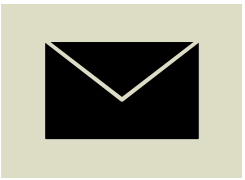
Mastery assessments (“exams”).
Test new skills.
Corrections allowed.
After each module.

Late work

Late work is accepted (details below). If you need time for an assignment, tell me. Give a reason, if it provides context. If you face debilitating circumstances or have overwhelming concerns of wellness, contact: me, a trusted mentor, U of A Cares (uofacares.uark.edu), or the Wellness Center (health.uark.edu).

Many icons: nounproject.com (some from Mac OS X Pages)

Resources

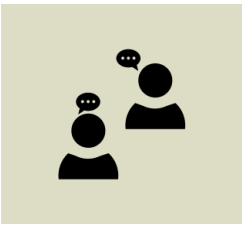


Email

Your questions are important. Email me or post to Blackboard. (I may ask you to do this anyways.) Responses may take 24 hours, but send a reminder if I do not reply.

Office hours

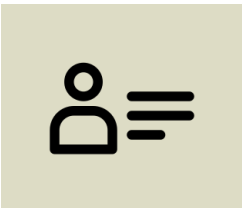
Ask anything you like in office hour! Being a student today is extra stressful — if you want to discuss your life or future outlook, I will lend an empathetic ear. During the semester, there will be three (3) office hours.



Appointments

Office hours will not always fit your schedule. Email me to set appointments. In your initial message, please explain (i) what you want to talk about, (ii) *your* availability and (iii) if meeting in person is important (Zoom is possible).

Class formation



Names and pronouns

You deserve to be called how you want. Let me know your preferred name and pronouns any time. When meeting one another, re-introduce yourself *frequently.* Everyone's names, pronouns, etc. should be known and properly used.

Academic integrity

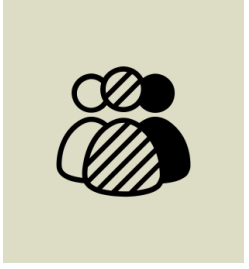
I trust my students to follow (i) the University of Arkansas Academic Integrity Policy and (ii) my own explicit assignment instructions. When you have questions about a boundary or rule, ask me rather than assuming you know the answer.

Access

I want you to pass this class, with success. If you find resources not being provided, tell me and I will work with you to fix the issue. For some students, the Center for Educational Access (cea.uark.edu) can coordinate student accommodation requests. Please request your accommodation letter early semester and meet me to discuss it.

Diversity

I welcome all forms of participation. I pledge attention for your identity and experience, regardless of your age, background, beliefs, ethnicity, gender identity and expression, national origin, racial identity, religious beliefs, sexual orientation, and any other visible or non-visible categories. Please acknowledge the same for your peers.

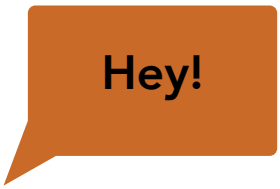


Tips for success

Read!
Before class.

Post!
To Blackboard.

Collaborate!
In class. With peers.



Conference!
With me.

Practice!
Repetition is key.

Budget!
Give yourself time.

More tips: We all get stuck and frustrated.

- Take a break.
- Explain to someone why you are stuck.
- Check hypotheses or assumptions.
- Work out a single example.
- Keep going!

Schedule overview

Module 0 (2 weeks)	August 22 - September 2. Introduction to number theory. Introduction to Python.	Reading: Ch. 2-3. Python: Computation and lists. Project: Initial brainstorm.
Module 1 (2 weeks)	September 5 - September 16. Essential properties of numbers. Distributions of primes.	Reading: Ch. 5-7. Python: Functions and loops. Project: Conversations.
Module 2 (3 weeks)	September 19 - October 7. The congruence relation. Modular arithmetic.	Reading: Ch. 8-13. Python: Logic and strings. Project: Group organization.
Module 3 (3 weeks)	October 10 - October 28 Practical modular arithmetic. Intro to public-key cryptography.	Reading: Ch. 16-18. Python: Applications. Project: Proposal due.
Module 4 (4 weeks)	October 31 - November 25 Quadratic equations. Sums of squares.	Reading: Ch 20-24. Python: Applications. Project: Outline due.
Module 5 (2 weeks)	November 28 - December 9 Fun with cubic equations (elliptic curves). Student presentations.	Reading: Project! Python: Project! Project: Yes, project!

Process

Processing is a major way to participate in MATH 3203. Frequent readings help you process material. You will record answers to short questions and regularly share them in class.

Reading assignments and guides (one per reading)

Read the text. Focus on highlighted passages.

Need extra help? Watch videos I suggest, or find your own.

Bring finished reading guides to class for credit!

Python tutorials (at least once per week)

Fridays are Python days. Get ready with tutorials!

Some distributed and collected through cocalc.com.

Others available on datacamp.com. (Free.)

Prepare for class.	Credit for effort.

Late work

Reading guides accepted late once per four readings. Python tutorials not accepted late.

Engage

You engage material by solving exercises, including proof writing. We share examples and techniques in class. Out of class, you write up solutions to selected exercises.

Explorations

Python-based problem solving.

One per week.*

Connection readings

One per module. One page responses.

*Except during weeks following a Mastery Assessment.

Late work

Exercise sets are always accepted. Reading responses

Collaboration

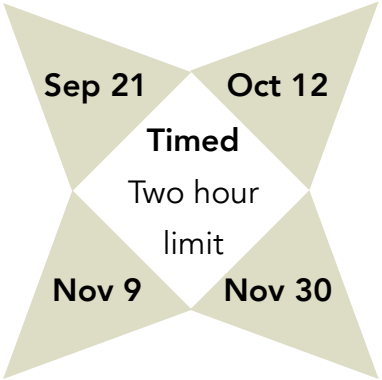
Using peers and extra resources is encouraged. Sources must be acknowledged. Anything you turn in must reflect your personal understanding.

Assess

Mastery assessments are your chances to show overall knowledge, then make corrections and grow. You will be assessed on the four main modules.

Take-home

Five day windows



Corrections

10% back

By end of term

Extra resources?

You may consult class materials, the text, and use Python.

You may *not* search the internet for *mathematical help* during the assessment.

Project

The project allows you to learn beyond the course. Each module includes a step in the process. Most of the work will be in groups. Together, you produce a 20-minute presentation, including Jupyter demo, and a term-length paper.

0 Think it out!

Browse the text and search the internet. Post a list of topics.

1 Talk it up!

Discuss with me and others. Expand on your interests.

2 Organize ourselves!

Form groups based on recommended topics.

3 Work together

Write a shared proposal for your group's main goal.

4 Plan your path!

Write a shared outline of your project. Include a bibliography.

5 Finish it up!

Write your paper, presentation, and Jupyter demo.

Grading

You earn credit for every portion of the project. Modules 0, 1, and 2 are for credit. Your proposal and outline, along with each of the three project components, will be graded based on pointed rubrics.

Rubrics

Modules 0, 1, and 2

- Spend time brainstorming and discussing. Graded upon completion, but the effort is worth it!

Proposal (2-3 paragraphs)

- Is a precise, motivated, investigation proposed?
- Is there a substantial mathematical element?
- Is computing clearly integrated?

Outline (1-2 pages)

- Is there a clear plan for the project?
- Is there room for background and content?
- Is there a sufficient bibliography?

Presentation with Jupyter demo (15-17 minutes with time for questions)

- Did the presenters motivate their investigation?
- Did the presenter explain their main outcome?
- Did the presenters explain mathematical substance?
- Did the presenters incorporate Jupyter?
- Are visual or audio effect crisp and clear?
- Did the presenters raise and address questions?

*Paper (8+ pages, double-spaced, 1" margins, 12 pt. font) - **Due Monday December 12 by 5:00 PM.***

- Is the paper properly long and formatted?
- Is there a significant mathematical quality?
- Is the work neatly presented?
- Is there an introduction with a clear thesis?
- Are the contents described and easy-to-follow?
- Does the body of the paper support the thesis?
- Is there a theoretical component
- Is the theory presented in a logical fashion?
- Is there an illustrative example?
- Overall, is the mathematics correct and justified?
- Is there a clear conclusion justifying the thesis
- Does the paper suggest further directions?

Late work?

Late work for Modules 0-2 is accepted.