Math 3354: Survey of Algebra

Spring 2023
Instructor: Walker H. Stern
Email: ws7jx@virginia.edu
Office: Kerchof 311

Class Meetings: TuTh 11:00am-12:15pm, Clark Hall 102

Office hours: TuTh 4:00-5:00pm in Kerchof 311 or by appointment. *If you cannot make it to these office hours, please let me know as soon as possible.*

Course format: This course will not consist of traditional lecture, but rather will be structured around what is known as *inquiry-based learning*. This means that, in class, we will all work collaboratively to answer questions and *discover* mathematical concepts.

The course will consist of in-person collaborative work together with homework, writing assignments, and presentations. Each student is responsible for keeping up-to-date on course material.

Resources: Because of the atypical course format, it is essential that you avoid consulting resources other than those provided on the course website/canvas page.

Course Overview: Group theory is the formal mathematical study of symmetries, but it also intersects profoundly with linear algebra, geometry, and the theory of polynomial equations. Because of the ubiquity of symmetry in mathematical reasoning, groups, their properties, and related notions manifest in nearly every branch of mathematics. This course will provide an introduction to the theory of groups, focusing on the relation of groups to symmetries, and laying the groundwork for further study of mathematics.

Among other topics, this course will cover groups, subgroups, quotients, symmetric groups, homomorphism theorems, the theorems of Cayley and Lagrange, group actions, basic modular arithmetic/number theory, and some classification results. Time permitting, we will discuss crystalographic subgroups, discrete subgroups of isometry groups, and/or basic ring theory.

Evaluation & grading

Percentage grades for the course will be assigned according to the following weighting:

Homework	20%
Class participation	10%
Notes	15%
Presentations	15%
Midterm	20%
Final	20 %

Homework: There will be weekly written homework assignments, which will be handed in via Gradescope. Gradescope is available from the course Canvas page. You will be expected to hand in assignments in **groups of 3 to 5 students**, with **one submission per group**. You are expected to put the name of **every** group member on each assignment, and to submit as a group on Gradescope.

Reflections: Each homework assignment will contain one exercise, to be handed in individually, which will ask you to write a brief reflection about your mathematical process. These will be submitted on a separate Gradescope assignment, and will be graded pass-fail.

Participation: Each class session will consist of whole-class discussion, group work, or mini-presentations. You are expected to participate in these activities, and put effort into working with your group.

Notes: There will be a common, online LaTeX file, in which course notes will be kept. At the beginning of the semester, you will choose groups of 3-5 students with whom you will work for the rest of the semester. Each week, one group will be responsible for typing up notes and explanations for the material worked out in class. At the end of the week, I will provide comments and feedback on the new notes section, which the group will then be expected to implement to get full credit.

Presentations: At the beginning of each week, the group responsible for the previous weeks notes will schedule a meeting with me to give a short presentation of the material from the previous week.

Midterm: There will be a single midterm, tentatively scheduled for the week of **13th March, 2023**. It will be a take-home, written exam.

Final: There will be a single in-class written final. The final examination will be cumulative, meaning any material from the course will be fair game to appear on the final. The exam will take place **Tuesday, May 9th 2023, 9:00am - 12:00pm**, at a location to be determined.

Attendance

Because of the discursive nature of the course, **attendance is mandatory**. Repeated absences will result in a reduction of your participation grade. If you need to miss a class session for some reason, contact me as early as possible beforehand.

Deadlines, make-up exams, and late work

As a general rule, late work will not be accepted and late assignments will be given no credit. In exceptional cases, extensions may be granted due to extenuating circumstances.

Exams: Make-up examinations may be permitted where serious scheduling conflicts arise. **If you are aware of a potential conflict beforehand, you must contact me to request a make-up at least one week before the examination date.** Otherwise, no make-up examination will be permitted. If an emergency arises which prevents you from attending an examination, you should contact me as soon as possible to discuss a make-up examination.

Presentations: These are scheduled with me on a weekly basis, and should be scheduled so all group members can attend. In the event that a conflict arises, we will reschedule the presentation.

Proofs and mathematical writing

This course is proof-based, which means that students will be expected to read, write, and understand mathematical proofs. More broadly, by the end of the semester, I expect that you will be able to write cogently and clearly about mathematics. Since formal mathematical writing will be a new experience for many of you, there are multiple ways you will get feedback on mathematical writing:

- *Homework.* On the homework, you will be asked not just to ascertain what is true, but to *prove* that it is true. The homework will be graded both on the accuracy of the statements you make, and the clarify and correctness of the proofs. **On early homeworks, more written feedback will be provided on proof writing, and grading will be gentler. As the course progresses, I will gradually begin expecting more of your proof-writing skills.**

- *Notes.* When it is your group's turn to keep the notes for the week, I will read your week's notes, and give detailed feedback. Implementing this feedback will be another way for you to develop your mathematical writing abilities.

Mental Health & Wellbeing

University study can be stressful, and the material in this course will likely be very new for many of you. You should always feel free to contact me, both with questions about the material and with any other concerns about the course.

The University of Virginia offers a number of helpful resources for students. Psychological counseling for students is provided by Counseling and Psychological services (CAPS). Alternatively, there is the anonymous HELP line run by Madison House.

Disability accommodations

If you have a disability, or think you may have a disability, you may want to meet with the Student Disabilities Access Center (SDAC), to request an official accommodation. If you have already been approved for accommodations through SDAC, please make sure to send me your accommodation letter as soon as possible, and meet with me so we can develop an implementation plan together.

Religious accommodations

If your religious practice will conflict with any of the course meetings, exams, or other course requirements, I will work with you to find a way for you to complete the course requirements without impinging on your religious observance. If you wish to request religious accommodation, please send me an email as far in advance as possible.

Academic honesty

All exams in this course fall under the purview of the UVA honor code. Additionally, and specific to this course, **you should not consult outside resources for this course.** Because significant consultation of outside resources will harm your learning and that of the other students, it will be considered cheating.

Instructor Communication

Throughout the semester, I will send you emails through the course Canvas page. You are responsible for the contents of these communications. These communications may include the scheduling of examinations, canceled or rescheduled classes, or information about homework. You may communicate with me via email, Canvas, or wandering into my office. **Note: I will primarily answer emails during normal business hours. Emails received at night, on weekends, or on holidays may go unanswered until the next work day.**

Meet your instructor:

This is my sixth semester as a postdoc at UVA. Before coming here, I worked as a postdoc at Universität Hamburg in Germany. I completed my doctoral studies in 2019 at Universität Bonn, also in Germany. I specialize in higher category theory — a branch of mathematics sometimes referred to as "generalized abstract nonsense." For anyone interested, my professional webpage is walkerstern.gitlab.io