Prerequisites: Math 220 (Higher Mathematics: An Introduction) or its equivalent is required. In addition, I recommend that you take the first linear algebra course (Math 222) or Differential Equations with Linear Algebra (Math 241) prior to or concurrently with this course.


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Office Hours: Mondays and Wednesdays 10:00–11:00 a.m. in the Math Lab, Darwin 108. Also by appointment or discovery–if my office door is open, feel free to come by.

Texts: Groups and Symmetry: A Guide to Discovering Mathematics, by David W. Farmer, and A Book of Abstract Algebra, 2nd edition, by Charles Pinter. We will cover chapters 1 through 6 of Farmer early in the semester, and then move into Pinter.

Proofs: Though you have had some experience with writing and discovering proofs, you will become much better at it during this course. Indeed, one main objective of the course is that you become confident in reading and understanding proofs in texts, and in inventing proofs of your own. This can be a difficult process!

There will be proofs on every exam, and in every homework assignment. The purpose of this is not to scare you, but to emphasize the above objective. Please come to my office hours if you feel you aren’t understanding the proofs, and we’ll work on it.

Reading the text: You must do the readings as they are assigned. Imagine attending a literature seminar without doing the reading before attending the class at which it will be discussed!

To facilitate your reading, I will prepare a “reading summary” to accompany some of the readings, which will consist of a few questions you should think about as you read. You should answer these as you go, though you are not expected to be able to fully answer all the questions based solely on reading. These summaries will form the basis for our discussion in class—if nobody has trouble with a particular item, we won’t have to spend time on it. This frees up time for the hard stuff.

Notes: You need some place to keep your notes from class work and from your reading in good order. I encourage you to devote a bound notebook to this: Work on in-class tasks and home tasks (such as the tasks in Farmer or reading questions accompanying Pinter) can both go in here.

Tests: On the exams you may use two letter-size pages (total of 187 square inches) of notes in your own handwriting (no printed or copied material). There will be one midterm exam and the final. Any make-up exams must be arranged with me before the scheduled exam. Make-up exams may be harder than the originals.
**Learning objectives:** Your goal for the class is to develop as much proficiency as possible in the techniques and content which we will explore. This is a *learning goal*, as opposed to a *performance goal*, in which your task is to win positive judgements and avoid negative ones. (Carol Dweck, *Self-theories*, Psychology Press, 2000; see blog post link on website). In many school settings, you may have grown used to thinking in terms of performance goals.

The trouble is that, as Dweck says, “The tasks that are best for learning are often challenging ones that involve displaying ignorance and risking periods of confusion and errors. The tasks that are best for [achieving performance goals] are often ones that students are already good at and won’t really learn as much from doing.”

We will aim to spend very little time on things you already know how to do. You grow in your understanding by hard work on challenging tasks. Thus, if a task which I have assigned is easy for you, then it’s your job to extend it, find a harder version, etc. If a task seems so challenging that you don’t know how to approach it, then—after working on it with significant effort—your job is to come to me and/or a classmate for ideas.

**Homework:** There will be four problem sets which will constitute the majority of your grade. In addition, there will be daily homework problems, which you will discuss with your classmates but not hand in. Some of these problems might be hard, and it is OK if sometimes you can’t get all of them.

**Schedule, Grading:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Item</th>
<th>Points</th>
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<tbody>
<tr>
<td>September 15</td>
<td>Problem Set 1 due</td>
<td>35</td>
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<tr>
<td>October 6</td>
<td>Problem Set 2 due</td>
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<tr>
<td>October 20</td>
<td>Midterm Exam</td>
<td>45</td>
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<tr>
<td>November 3</td>
<td>Problem Set 3 due</td>
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<tr>
<td>December 1</td>
<td>Problem Set 4 due</td>
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<tr>
<td>December 13</td>
<td>Final Exam</td>
<td>60</td>
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<td></td>
<td>Class Participation</td>
<td>40</td>
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</tbody>
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**Reading for Week 1**

**Monday, August 30:**  
(1) **Read** the Syllabus and “Discovering Proofs” (on website).  
(2) Complete the reading and **all tasks** in Farmer Chapter 1.  
(3) **Read** pages 1–9 in Pinter.  
   (a) What is algebra?  
   (b) Why might it be useful to be able to solve an equation?  
   (c) If $A, B, C$, and $D$ are $2 \times 2$ matrices with $A \neq 0$ and $AB = AC$, you can’t conclude that $B = C$. Is there anything useful that you *can* conclude?  
   (d) What are some themes which run through all the number systems which you know something about (integers, reals, etc.)?

**Wednesday, September 1:**  
(1) Complete the reading and all tasks in Farmer chapter 2.  
(2) **Read** the rest of Chapter 1 in Pinter.  
   (a) What is one additional identity in Boolean algebra (set theory) that is not true in the real numbers (besides those on page 10)?  
   (b) What is an *algebraic structure*? Why is it called that?  
   (c) In the set of whole numbers ($\{0, 1, 2, 3, \ldots\}$), does every element have an inverse? Does the question make sense?  
   (d) Can you solve the equation $2 \perp x = 4$? Why or why not?