

# Linear Algebra

Math 110, UC Berkeley Summer Session 2017

## 1 Course Overview

### 1.1 Goals

Math 110 is intended to be a second course in linear algebra. The primary goal of the course is to develop a deeper, more conceptual understanding of linear algebra. To achieve this goal, we'll be developing linear algebra theoretically from the ground up.

Strictly speaking, no prerequisites are *absolutely necessary*, but practically, you'll find it indispensable to already have some intuition about linear algebra from a course like Math 54. You may also find it useful to have taken a course involving writing mathematical proofs, such as Math 55, but this isn't essential — one of the things we'll be working on in this class is writing rigorous arguments.

### 1.2 Content

The textbook for this course is the third edition of Sheldon Axler's *Linear Algebra Done Right*, and our goal is get through chapters 1 through 8. We'll follow it fairly closely — the only thing we'll do differently is that we'll insert chapter 8 in between chapters 5 and 6.

### 1.3 Philosophy

In the traditional course, students spend the bulk of class time *listening* to lecture, and are then expected to go home and work on *understanding* the class material by themselves. There's something perverse about this: the hard part about math isn't listening to math (or, for that matter, reading about math), it's understanding and doing math. But the hard part is exactly what students are left to do largely on their own.

There's a pedagogical method called "peer instruction" that tries to address this problem: it moves information delivery *out of* the classroom, and as much information assimilation as possible *into* the classroom. A growing body of research suggests that it's quite effective: by certain metrics, it seems to lead to an improvement over traditional methods by over a

factor of two! I haven't ever taught a course in this format before, but these results lead me to feel that it's worth trying out.

So, here's to experimentation!

## 2 Course Structure

### 2.1 Before class

On the course website, you'll find a table that looks as follows.

Date	Reading	Comprehension Questions	In-class Questions
<b>x</b>	<b>a</b>	<b>b</b>	<b>c</b>

By 11 pm the night *before* date **x**, you'll be expected to have done the following things.

- (a) You'll have read the assigned sections **a** from the textbook.
- (b) You'll have sent me an email containing three things.
  - (i) The date **x** in the subject line. (Note that **x** is *not* the same as the date you'll be sending me the email.)
  - (ii) An attachment of a picture/scan of your best attempt to complete the comprehension questions **b**.

I don't intend for this to be a grueling task, just something to give you some incentive to read actively: there won't be too many comprehension questions, and they won't be too difficult. They will be graded purely for completion: if it looks to me like you made a reasonable attempt at solving them, you'll get full credit.
  - (iii) A question relevant to the reading. Here are some suggestions for the kinds of things you might decide to email me.

- Something that you're confused about from the reading.
- A comprehension question you're struggling with.
- Older material that you thought you understood, but, after reading the new material, you've decided that you're actually confused.
- Something in the reading that confused you momentarily, but then you managed to figure out why you were confused and resolved the confusion. (In this case, I'd really like to hear about how you resolved your confusion too!)

Again, my intention is not for this to be a burden. I'm partially just looking for some indication that you're actively engaged and keeping up with class material, but mostly I want to hear a bit about what you are finding confusing so that we can spend more time on those things in class. Things you are confused about are almost certainly things that others in the class are struggling with too.

I won't be able to respond to all of the emails individually, but I will look through them all and I'll do my best to tailor class around your questions.

## 2.2 During class

I will begin the class with a brief 20-30 minute summary of the reading. This is *not* intended to be a substitute for having done the reading: it's just to remind all of us what we're going to be thinking about today.

We will then spend most of the remainder of class time solving problems in the following format.

- I will put a problem on the board (usually a true/false question) and then ask you to spend a minute or two thinking about the problem in silence by yourself.
- We'll vote on an answer to the problem.
- We will then have a discussion period, where you discuss the problem on the board with your neighbors. Try to convince them about your answer, or make them convince you of theirs.
- We'll have a revote.
- Finally, I'll tell you how I would go about solving the problem.

At the end of class, I'll try to budget some time for you to ask any questions you'd like to ask.

## 2.3 Problem Sets

You'll have a problem set due every Thursday at the beginning of class. You'll get some points for attempting all of the problems. One problem will be picked at random and graded for correctness (which includes writing rigorous proofs using complete sentences).

## 2.4 Assessments

On Thursdays, during the first 30 minutes of class, we'll take a quiz. The quizzes will all be *cumulative*, but there will be a slight emphasis on the kind of problems we've discussed during class previously that week (ie, the same material that's on the problem sets due that day). The quiz will be in two parts. The first part will be true/false questions, the second part will involve writing complete proofs. For bureaucratic reasons, we'll call the 4th quiz the "midterm."

On the very last day of class (Thursday 8/10), we'll take the final exam. It'll be a 2 hour exam, and you *must* to take the final in order to receive a passing grade in the class.

### 3 Grading

Your final grade will be composed of the following.

Daily progress*	7%
Problem sets (7)	14% (2% each)
Quizzes/Midterm (7)	49% (7% each)
Final	30%**

\* Your “daily progress” score will be computed as follows. You’ll get 1 point for every day that you complete the assigned comprehension questions, and 1 point for every day that you email me a question. Your daily progress score will be the sum total of the number of points you accumulate this way, out of a maximum of 40 points. (There are roughly 30 days of class total, so you don’t need to do both things every day.)

\*\* If your final grade is higher than your lowest quiz/midterm score, I’ll automatically count your final 37% and drop the lowest quiz/midterm score. In particular, this policy will automatically come into effect if you must miss one quiz/midterm for any reason (no need to warn me in advance).

### 4 Miscellaneous

- It’s in your best interest to *get ahead on the reading*.
- I highly encourage all of you to *read each others’ proofs* (especially after you’ve done the problem yourself). Getting a classmate to read your proof can give you valuable feedback about any parts of your argument that are unconvincing or need to be clarified. Conversely, trying to assess if a classmate’s proof is correct will encourage you to think clearly and logically about what a complete proof looks like.

That said, *please* don’t just copy each others solutions or solutions you may find on the internet. Cheating is an enormous bureaucratic mess that none of us want to get involved with.

- If you’ll need DSP accommodations, please let me know as soon as possible so I can make the necessary arrangements.