

## Course Syllabus

### Course Syllabus, Math 540: Honors linear algebra, Summer 2021

Tuesdays and Thursdays, 10:30am-11:50am, [Zoom meeting 917 1056 9497](https://brown.zoom.us/j/91710569497)  
(<https://brown.zoom.us/j/91710569497>) linked in Canvas (left sidebar, click Zoom)

Instructor: [Melody Chan](http://www.math.brown.edu/~mtchan/) (<http://www.math.brown.edu/~mtchan/>)

To help me stay organized and respond promptly, please use this e-mail address to reach me about all Math 540 related things:

[melody\\_chan+linear@brown.edu](mailto:melody_chan+linear@brown.edu) ([mailto:melody\\_chan+linear@brown.edu](mailto:melody_chan+linear@brown.edu))

Yes, that's a plus sign. I'm filtering my emails so that emails to this address go directly in a course folder, which I will check twice a day. You can use "+" signs to organize your gmail too! [Here's how](https://support.google.com/a/users/answer/9308648?hl=en) (<https://support.google.com/a/users/answer/9308648?hl=en>).

Office hours: TBD and by appointment, same Zoom link as class

Teaching Assistant: Nathan Zelesko [nathan\\_zelesko@brown.edu](mailto:nathan_zelesko@brown.edu)  
([mailto:nathan\\_zelesko@brown.edu](mailto:nathan_zelesko@brown.edu))

Graders: Nathan Zelesko and Sejin Park [sejin\\_park@brown.edu](mailto:sejin_park@brown.edu)  
([mailto:sejin\\_park@brown.edu](mailto:sejin_park@brown.edu))

[Click here for the course schedule, including links to all assignments and due dates.](#)

[Click here for the running course notes in PDF.](#) 

([https://canvas.brown.edu/courses/1085319/files/64094823/download?download\\_frd=1](https://canvas.brown.edu/courses/1085319/files/64094823/download?download_frd=1))

I will try to keep up with writing these notes, but they take a lot of time for me to write, so I don't absolutely promise them.

## Course description

This is a one-semester undergraduate course in linear algebra, the study of vector spaces and linear maps. These structures play a fundamental role in all branches of mathematics, as well as nearby fields of physics, engineering, and computer science. We will give a theoretical and rigorous treatment of linear algebra. We will also take the opportunity to give an introduction to proofs and to mathematical writing, with plenty of practice. I will expect lots of work outside of class from you. I expect the course to be challenging and commensurately rewarding.

**How should you pick between Math 540 and Math 520?** Well, the two courses have a lot in common, since both are first courses in linear algebra. What about the differences? An analogy I like to use is to cars. 520 is a little more like driving lessons, learning to drive a car well so you can get around, and 540 is a little more like peering under the hood to see how and why cars work. If you're interested in cars mainly as a tool to get around and see places, then 520 is a better match. If you're curious about the systems inside that make cars run, and gaining a theoretical understanding because, e.g., you want to build other stuff or to practice the important associated skills, then 540 is for you.

So the difference between 520 and 540 is, in my opinion, less about "level" -- the name "honors linear algebra" is a bit misleading -- and more about what your goals are. Of course, 540 requires lots of work and practice, and it is imperative that you keep up with the assignments, which build vertically on each other. **In particular, expect to be doing work for Math 540 every single weekday, and handing in work three times a week; see the schedule below.** Think of it like an introductory language course. There should be daily practice/drilling that you should do to get fluent with the basic structures, plus more complex writing assignments to use those structures in more complex ways. With lots of practice, you can absolutely learn a ton about linear algebra and mathematical proof.

If you are unsure about whether to take this course, please feel free to discuss it with me.

### **So... how is it going to work virtually?**

We'll do class and office hours on Zoom. Class meets synchronously, at the scheduled time of Tue/Thu 10:30am-11:50am. I encourage you to participate in class at the scheduled time, as you will have the opportunity to ask questions, have occasional discussions, and check your understanding live through short polls.

But if you have to miss class, don't fear. The course will be recorded, and recordings of the

lectures will be posted in the Media Library tab (left sidebar).

## Topics

Basics of sets; how to write proofs. Vector spaces and linear maps. Eigenvalues, eigenvectors, invariant subspaces. Inner product spaces, operators on inner product spaces. Trace and determinant. Additional topics, time permitting.

## Textbooks

### Required textbook

Axler, Linear algebra done right, 3rd ed, Springer, 2015.

[Download the textbook here as a free PDF.](#)

[\(http://link.springer.com.revproxy.brown.edu/book/10.1007/978-3-319-11080-6\)](http://link.springer.com.revproxy.brown.edu/book/10.1007/978-3-319-11080-6)

You can also follow that link to order your own copy for \$24.99, or, it's also available at the bookstore for \$59.99 new. Make sure you get the newest edition (3rd edition).

### Supplementary textbooks

We may use parts of the following sources: the first, to get started with sets and quantifiers, the second to cover determinants, and the third if time permits for some cool additional topics.

Hammack, [Book of Proof, third edition, free PDF download.](#)

[\(https://www.people.vcu.edu/~rhammack/BookOfProof/Main.pdf\)](https://www.people.vcu.edu/~rhammack/BookOfProof/Main.pdf)

[\(https://www.people.vcu.edu/~rhammack/BookOfProof/Main.pdf\)](https://www.people.vcu.edu/~rhammack/BookOfProof/Main.pdf) Treil, [Linear algebra done wrong, free PDF download.](#) [\(https://www.math.brown.edu/streil/papers/LADW/LADW\\_2017-09-04.pdf\)](https://www.math.brown.edu/streil/papers/LADW/LADW_2017-09-04.pdf)

Silverman, [Supplementary notes for Math 540, free PDF download.](#)

[\(https://www.math.brown.edu/mchan2/LinearAlgebraPlus.pdf\)](https://www.math.brown.edu/mchan2/LinearAlgebraPlus.pdf)

## What are the components of your grade?

There are three parts to the course grade:

(1) **Review sheets.** Think about these like the daily worksheets with kind of practice and drilling of individual components and skills that you might do in an introductory language course. Or, for classical musicians, the analogue of practicing scales, arpeggios, shifts, etc. They are due a day after they are posted. That is, they're posted by Tuesday and Thursday, due Wednesdays and Fridays at 11:59pm.

(2) **Problem sets.** Problems will be posted to the problem set after each class and are due weekly on Mondays at 11:59pm. Think of these as longer-form, deep thought problems that you should chew on over the course of the week. The analogue in a language course might be short essay; the analogue in music might be working on passages from an actual piece. Problems will be posted on Tuesday and additional problems will be added on Thursdays, and they are due the following Monday. *You are welcome and encouraged to collaborate on these; see collaboration policy below.*

(3) **Examinations.** You will have three exams, one in Week 4, one in Week 9, one on August 12 at the scheduled date of our final exam. They are equally weighted towards the final grade. These are meant to spur you to study carefully and crystallize your knowledge, and to assess your knowledge and skills. *You may consult your textbook, this Canvas page, and all of your notes. You may consult internet sites only at the level of generality of Wikipedia (if you wish---frankly I think this is unlikely to be helpful). But absolutely no collaboration on the assessments or seeking help from anyone on the problems.*

**Lateness policy.** No late work will be accepted, other than very extenuating circumstances which should be presented to me, which I will expect will be rare. Instead, your lowest **one** problem set grade and your lowest **two** review sheet grades will be dropped.

Here is a typical weekly schedule.

Monday: Problem Set Due 11:59pm, or, exam posted and due.

Tuesday: Attend class. Review sheet posted.

Wednesday: Review sheet due 11:59pm.

Thursday: Attend class. Review sheet posted.

Friday Review sheet due 11:59pm.

**How your grade is computed**

## How your grade is computed

***The following breakdown is tentative. I will finalize these by the first day of class.***

- (1) Review sheets: 30%. No late work accepted, but drop your lowest two scores.
- (2) Problem sets: 25%. No late work accepted, but drop your lowest score.
- (3) Exams: 45%.

The grading system is as follows: **a 90% guarantees an A, 80% guarantees a B, a 70% guarantees a C.** In the case of a grade very near those cutoffs, something like within 2 or 3 points, I will look very carefully at the totality of the work submitted for evidence of growth over time.

## Gradescope

We will be using Gradescope to handle all submissions of review sheets, problem sets, and exams. Click Gradescope on the left sidebar. [Here is a link](https://help.gradescope.com/category/cyk4ij2dwi-student-workflow) (<https://help.gradescope.com/category/cyk4ij2dwi-student-workflow>) with general information on how to use it.

## Scheduling notes

*This course meets as usual during reading week.*

## Collaboration policy

You are encouraged to work with other students in the class. Please do not consult anyone outside the class on the problem sets, unless you petition me for an exception. (Usually I don't permit anything of this sort, but I recognize that there's a lot of isolation right now and we should try to take all the mathematical connections we can get.)

In any case, you are required to write up your solutions on your own, and write the names of the students with whom you worked on the assignment. *You may only use the Internet as a general reference, at the level of generality of Wikipedia.*

## How much time will this class take?

Roughly speaking, you should expect to spend twelve hours every week outside of class, including attending office hours, reviewing class material, doing problem sets and review sheets. In addition to three hours of class every week, I estimate a total of  $15 \times 13 = 195$  hours of time spent on this class.

## Accommodations for students with disabilities

Any student with a documented disability is welcome to contact me as early in the semester as possible so that we may arrange reasonable accommodations. As part of this process, please be in touch with Student and Employee Accessibility Services by calling 401-863-9588 or online at

[http://brown.edu/Student\\_Services/Office\\_of\\_Student\\_Life/seas/index.html](http://brown.edu/Student_Services/Office_of_Student_Life/seas/index.html)

([http://brown.edu/Student\\_Services/Office\\_of\\_Student\\_Life/seas/index.html](http://brown.edu/Student_Services/Office_of_Student_Life/seas/index.html))

## Acknowledgments

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