Matrices and Linear Transformations
21-241
Summer II 2019

Course Information

Times:	MTWRF 10:30–11:50 a.m.
Location:	4709 Wean Hall
Units:	10
Webpage:	http://math.cmu.edu/~cocox/teaching/matrices2019/

Instructor Information

Instructor:	Chris Cox
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Office:	6201 Wean Hall
Hours:	MWF 12:00–2:00 p.m.
Grader:	Zeyu Zhang
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Office:	7207 Wean Hall

Textbook

There is no official textbook for this course, but I have included links to two supplementary texts. I will not teach directly from either of these books, but you are encouraged to read any relevant chapters. They both include many excellent examples and exercises along with slightly different perspectives on the material. I may also assign some problems directly from these books.

- **Linear Algebra** by Jim Hefferon.
  - Freely available at http://joshua.smcvt.edu/linearalgebra/ under the terms of the GFDL or the CC BY-SA 2.5.
- **A First Course in Linear Algebra** by Robert A. Beezer.
  - Freely available at http://linear.ups.edu/download.html under the terms of the GFDL.

Course Description

This course is an introduction to Linear Algebra: one of the foundations of mathematics. We will cover topics such as real and complex vectors and matrices, solving linear systems, abstract vector spaces, linear transformations, inner products of vectors, change-of-basis formulas, determinants, eigenvalues and eigenvectors, and much, much more!

This course will involve not only learning how to use linear algebra to calculate things, but will focus on proving basic results and theorems in this area. If you have never had any experience with a proofs-based course before, imagine if your calculus course focused mainly on *why* limits, derivatives and integrals work the way that they do instead of spending the majority of the time calculating them. While we will certainly spend time

on calculations involving matrices, vectors, etc., the majority of our time will be devoted to understanding these objects and justifying their properties and uses. Understanding how these objects behave in general allows us to be able to apply them in any number of situations!

Prerequisites. While there are no official prerequisites for this course, it is strongly recommended that you have at least had a basic calculus course such as 21-127. While we will not explicitly use any calculus, we will likely use some basics as motivation for examples.

Beyond this, it is expected that you are familiar with complex numbers and polynomials as these will be used heavily throughout the course. Additionally, already having a basic familiarity with matrices and vectors will be beneficial since we will cover the basics very quickly.

Finally, it is not necessary that you have had any experience with proofs prior to this course. We will discuss basic proof techniques and methods as the course unfolds.

Homework

Homework exercises are an essential part of this and any course. It is difficult to fully understand the material without working through the homework problems in a thoughtful manner, especially since this is an accelerated summer course. Homework is especially important as this course will build upon itself, so if you lack the understanding of a certain topic, this will make understanding later topics more difficult. Take ample time to think about the problems posed, your strategies and the validity of your logic and explanations.

I encourage you to collaborate and form study groups. Learning collaboratively opens your mind to new ideas that you may not have considered and also forces you to clarify your own ideas. Nonetheless, copying any part of another person's homework is not permitted. To avoid what I could consider to be plagiarism, you must not write your assignment during collaborative sessions, but do so alone once your mind is clear. Not only will this help prevent cheating, it will also help you better understand the material.

There will be two homework assignments per week, generally due **Tuesdays** and **Fridays**; the exception being the final week. Assignments due on Tuesdays will be posted by class time on the preceding Friday, and assignments due on Fridays will be posted by class time on the preceding Tuesday. Since this is an accelerated summer course, there may be situations in which you cannot do all of the problems right away. For example, an assignment posted on Tuesday may require some materials that we cover on Wednesday. Homework assignments will be posted on the course webpage with solutions being posted on the day that the assignment is due.

Homework assignments must be turned in by the end of lecture on the due date. Only under grave circumstances, such as a documented medical illness, will I grant an extension on a homework assignment. If you are unable to attend a lecture, you are still responsible for turning in the assignment on time, by email or otherwise. There will not be any make-up assignments, but your worst two homework scores will be dropped.

Exams

There will be two exams in this course: a midterm and a final. The final exam is essentially just a second midterm in that it will not be cumulative. However, this is a bit misleading since the course will build on itself. That is, while the final exam will not explicitly test you on topics covered in the midterm, it will not be possible to pass the final without understanding and using the material covered in the first part of the course.

For each exam, you are permitted (and encouraged) to bring one standard 8.5×11 sheet of paper with notes. These notes *must* be handwritten and can take up both the front and back of the paper. You are not permitted to photocopy any other person's notes, but you may, of course, collaborate with others on what to include. Besides this sheet of notes, you are not permitted to use any other materials on the exam beyond your own smarts.

The midterm will take place on **Wednesday, July 17** during the normally scheduled class time, and the final will take place on **Friday, August 9** during a 3-hour block, which will be scheduled by the University Registrar's Office. The time and location of the final exam will be communicated to you once it is scheduled.

Participation

Time will not allow me to regularly check attendance in this class; however, it is expected that you will attend class regularly. If you do miss a lecture, you are responsible to find out what was covered.

The only exception to this will be on Fridays (and Thursday of the last week). Fridays will begin with a normal lecture, but the latter part will be what I call a discussion session. You will break into small groups to work through questions related to everything that we have covered in class that week together. These worksheets will not be graded, but they will give you the opportunity to discuss the material with your classmates and with me as I walk around.

Your participation in these discussion sessions constitutes 6% of your grade, 1% for each week.

Beyond the discussion sessions, participation is strongly encouraged at any and every other time. I ask a lot of questions during class and will want to hear your thoughts and ideas. Don't hesitate to go for it! If you have any questions during lecture, please interrupt me and ask. It is very possible that I have made a mistake, or at the very least, very likely that someone else has exactly the same question as you do.

Academic Integrety

Please review CMU's Academic Integrity Policy: https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html. Failure to abide by this policy or any of my policies laid out above may result in disciplinary actions being pursued as per university policy.

Grading

Homework 64%
Midterm 15%
Final 15%
Participation 6%

There will not be any make-up assignments, but your worst two homework scores will be dropped.

Take care of yourself!

I want you to enjoy this course, and I care about your mental state. Do not hesitate to talk to me for any reason. I encourage feedback, which you can provide by speaking to me or through email. If you encounter difficulties of any kind, I will be here to help you find a solution or to direct you to the resources you need; the sooner the better.

Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 or visit their website at https://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support you need.