

# MAT 211: Introduction to Linear Algebra

## Course Information and Syllabus

Course Instructor: Yusheng Luo —yusheng.luo@stonybrook.edu—

Welcome to MAT 211! Linear algebra is one of most widely used area of mathematics; it has applications in fields as varied as computer science, economics, engineering, epidemiology, ecology, physics, psychology, archaeology and statistics. It is also an elegant subject, known for being self-contained and logically cohesive. In linear algebra, we study linear transformations, an important group of functions that have many applications. We will start from a very concrete perspective, that of solving linear systems, but we will quickly see that we can also adopt a more geometric perspective, which is often useful. Linear transformations enable us to deal with higher dimensional phenomena as well as vast amounts of data.

As we progress through the course, the level of abstraction will increase. This is key, because it allows us to generalize our knowledge to broader and broader contexts. If time permits, we will also see how linear algebra we have learned can be applied to analyze and solve differential equations, which are used to model processes throughout the natural and social sciences.

## Prerequisites

Official requirement: C or higher in AMS 151 or MAT 131 or 141 or co-registration in MAT 126 or level 7 on mathematics placement examination.

You are expected to have had taken a semester course in calculus. You should feel somewhat confident in dealing with vectors. It will be helpful to know multivariable calculus, although this is not absolutely necessary. Most importantly, you should feel enthusiastic about the course!

## Course Goals

As with any college course, we hope that you will gain more from MAT 211 than simply factual knowledge. By the end of this course, we would also like you to:

- Be able to apply the concepts and problem solving strategies from this course to problems you encounter in the future.
- Become more skillful in thinking and reasoning abstractly.
- Have a mathematical foundation in linear algebra that will serve you well in future study, be it in mathematics, sciences, engineering, or social sciences.

## Class and Sessions

MAT 211 is taught in reasonably small classes rather than in a large lecture hall so that you have ample opportunity to ask and answer questions and interact with the me and fellow students. During the lecture

time, you will frequently be given time to try some of the problems in worksheet. This gives you a moment to digest, and test your understandings. Feel free to discuss your answers with the person next to you during this time, and let me know if you need any assistance. Please take advantage of this by being an active participant!

There are four different sessions for the course MAT 211. Different sessions are run independently but the depth of the materials are essentially the same.

## Textbook, Readings and Technology

The textbook we recommend is *Linear Algebra with Applications (5th Edition)* by Otto Bretscher. You may also use *Linear Algebra: A Modern Introduction (4th Edition)* by David Poole. The E-version of the second book can be accessed if you have purchased the WebAssign for the course.

MAT 211 is a fast-paced course which covers a lot of material. We will usually cover one section of the textbook per class. We will highlight the key concepts in class, but there will not be enough time to cover all the details. You will be expected to study the text to fill in the details. It is preferable to read through each section before it is covered in class and then again after it has been covered.

Some of your homework may require you to use the software *Mathematica*. It is available to download for all students via SoftWeb. The softwares are also available in many computer labs throughout the campus. A calculator will not be necessary for this course.

## Homework

Homework is an essential part of the course. The only way to learn math is by doing math. In general, homework problems will look different from problems discussed in class. This is intentional. The only way to develop a deep and flexible understanding of the material is to constantly practice applying it in different contexts. As you go through the homework, think carefully about the problems posed, the strategies you've used, and the meaning of the computations you've performed.

Homework problems will fall in one of three categories.

- Regular problems deal with the material covered in class. These problems aim to give you a basic mastery of the material so that you will be ready to apply it.
- Challenge problems are more involved problems that rely on the same basic concepts as regular problems. Because these problems are more involved and may require more creativity and flexibility to solve, we will usually give you more time to work on them. Typically, a challenge problem is worth twice as many points as a regular one.
- Exploratory problems introduce you to ideas or issues we will study more in later classes. Because these problems explore material we have not yet covered in class, we do not expect you to do them perfectly. Therefore, you will earn full credit for these problems as long as you show evidence of real thought and effort. Exploratory problems are very important in laying the groundwork to help you understand upcoming material.

## Homework Policy

Problem sets will be posted on the course website. Typically, you will have one assignment every week. Homework must be turned in at the start of each class on Tuesday. If you miss the class, you are still

responsible for handing in the homework on time. To be fair to other students and to the grader, late homework will **not** be accepted. We realize that occasionally things may come up that prevent you from giving full attention to homework. We will accommodate by dropping your lowest problem set score when computing your final homework grade.

You are welcome to collaborate with other students on solving homework problems. In fact, we encourage you to do so. However, you must understand and write up your homework by yourself. If you receive help from any source other than the instructor or the graders, please acknowledge that help at the top of your assignment. Your homework score will not be affected by this. Of course, it is always unacceptable to copy a solution from any source, and the university takes such infractions seriously.

When writing up your homework, we expect you to explain your thought process. Your final answer is less important than the reasoning you used to reach it. As a rule of thumb, if you are not using any works when writing up the problems, you probably aren't giving enough explanation. When writing out your answers, it may help to imagine that you are writing to a fellow student to explain how to solve the problem. This will help you include the right level of detail.

## Getting Help

Linear algebra is very different from calculus. There are many resources available to help you make the transition smoothly:

- Your fellow students. You are encouraged to form study groups with your classmates.
- Office hours. You do not need to make an appointment; just show up! My office hour:

Tuesday    1:30-2:30  
Thursday   1:30-2:30

- Math Learning Center. Go to as many as you like!
- By appointment. You can also send me an email to arrange a meeting if none of the above work for you.

We encourage you to make use of these resources. At the same time, don't be *too* quick to run for help. Learning to use linear algebra is challenging and takes time. You should not expect to solve every problem immediately. Try a couple of different approaches before asking for help. Often you learn the most from those things you try that don't work!

## Exams

Tentative exam dates are bellow.

Midterm 1	Oct. 10th in class
Midterm 2	Nov. 14th in class
Final Exam	Dec. 11th

Out of sequence exams are only offered for the following reasons:

- A medical excuse: please send the doctor's notes to me.

- A university-sponsored event such as an athletic tournament, play or musical performance. Please have your coach or director contact us in advance. Athletic practices and rehearsals do not count.
- A religious holiday: please send a brief email to me explaining your situation.
- Extreme hardship such as a family emergency: please contact to let me know.

## Grading Policy

The grading policy is designed so that you can represent your mastery of the material in a favorable light. Your course grade will be determined as follows:

- Midterm score: Take the higher of
  - 40% first exam + 60% second exam
  - 60% first exam + 40% second exam
- Course score: Take the higher of
  - 45% final exam + 30% midterm score + 25% homework
  - 30% final exam + 45% midterm score + 25% homework

## Disabilities requiring accommodation

If you need accommodation or assistance for a documented disability, please contact me as soon as you can. It's best to let me know well before the first exam, so necessary arrangements can be made. You should also contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

## Tentative list of topics

Gauss-Jordan elimination	Dimension	Eigenvalues and eigenvectors
Solutions of linear systems	The Rank-Nullity Theorem	Diagonalization
Linear transformations	Coordinates	Abstract linear spaces
Matrix algebra	The Gram-Schmidt Process	Abstract linear transformations
Image and kernel	Orthogonal projections	Inner product spaces
Subspaces of $\mathbb{R}^n$	Least squares and data fitting	Fourier series
Bases	Determinants	Using linear algebra to solve differential equations