

Course Syllabus: Matrices and Linear Transformations (21-241)

Carnegie Mellon University Spring 2023, Lecture 3

Syllabus Information: This syllabus serves as a contract between you the student, myself the instructor, and the course TAs. This document includes:

1. [General Course Information](#)
2. [Course Content and Learning Outcomes](#)
3. [Assessment and Grading Information](#)
4. [Weekly Schedule and Dates](#)
5. [Course Policies](#)
6. [Additional Information](#)

Please be sure to review the information in this document carefully. If you have any questions about the course, please **first** review this syllabus. If anything is unclear, you may then send an email asking for clarification.

General Course Information

Instructor: Dr. Elisa Bellah

Lectures: MWF 3-3:50pm in Doherty Hall 2302

Recitations: Please note that you must attend the recitation section you are registered for.

Recitation G: Thursdays 12-12:50pm in Porter Hall A18A

Recitation H: Thursdays 1-1:50pm in Gates and Hillman Centers 4301

Recitation I: Thursdays 4-4:50pm in Porter Hall A22

Textbook: [Linear Algebra and Applications: An Inquiry Based Approach](#), which is available online for free

Course Sites: There are four sites in this course you should become familiar with:

1. **Course Webpage:** Course documents and information can all be found on the [course webpage](#), which is housed on my website (andrew.cmu.edu/user/ebellah).
2. **Canvas:** [Canvas](#) will be used for announcements, concept quizzes, and to post grades. Lecture notes, activities, and recordings will also be stored in the "Pages" tab on Canvas. I suggest you change your notification settings on Canvas to receive emails when course announcements are posted.
3. **Gradescope:** All course grading and homework submissions will be done through Gradescope, which can be accessed through the sidebar on Canvas.
4. **Mentimeter:** Each lecture period will have an associated [mentimeter](#) survey. This site is free for you to access and does not require you make an account. If possible, please bring a phone or computer with you to access the survey for each day.

Supplemental Instruction: The Student Academic Success Center will be providing supplemental instruction for our course. Supplemental Instruction (SI) is a learning support model provided through the university that utilizes peer-assisted study sessions. The SI program provides weekly sessions that provide students practice with course content outside the classroom. See the [supplemental instruction](#) page for details.

Contact Information and Office Hours: You may attend any of the office hours listed below. Keep an eye out on Canvas for any scheduling changes.

Name (Role)	Email	Office	Office Hours
Dr. Elisa Bellah (Instructor)	ebellah@andrew.cmu.edu	WH 8119	Wed 4-5pm, Fri 2-2:50pm
Gbenuola Olaiya (Rec G TA)	golaiya@andrew.cmu.edu	WH 7201 (Mon) WH 6215 (Tues)	Mon 5-6pm Tues 12-1pm
Ayush Mediratta (Rec H TA)	ayushmed@andrew.cmu.edu	WH 6215	Thurs 5-7 pm
Sharon Xue (Rec I TA)	slxue@andrew.cmu.edu	WH 6215	Tues 1-3pm

Course Content and Learning Outcomes

Catalog Course Description: A first course in linear algebra intended for scientists, engineers, mathematicians and computer scientists. Students will be required to write some straightforward proofs. Topics to be covered: complex numbers, real and complex vectors and matrices, row space and column space of a matrix, rank and nullity, solving linear systems by row reduction of a matrix, inverse matrices and determinants, change of basis, linear transformations, inner product of vectors, orthonormal bases and the Gram-Schmidt process, eigenvectors and eigenvalues, diagonalization of a matrix, symmetric and orthogonal matrices.

Prerequisite: There are no prerequisites, but 21-127 (Concepts of Mathematics) is strongly recommended.

Learning Outcomes: The aim of this course is for you to learn the technical skills of linear algebra, and to develop some of the virtues that arise from mathematics education. By the end of the course, a successful student will be able to perform the following **technical skills**:

1. Identify which systems of linear equations are consistent, and find a complete solution;
2. Identify which square matrices are invertible, and find the inverse of an invertible square matrix;
3. Interpret matrices as linear transformations on vector spaces;
4. Be familiar with the language of vector spaces, including span, linear independence, basis; and dimension.
5. Find the rank of an $m \times n$ matrix, and describe the four fundamental subspaces corresponding to the matrix, including their dimensions;
6. Find the projection of a vector onto a subspace and interpret as the best least squares solution to a system of equations;
7. Find the determinant and eigenvalues of a square matrix and interpret them geometrically.

Students will also have developed some of the following **virtues** associated with a mathematics education.

1. **Persistence.** Throughout the course, you will be given problems that you are initially unable to understand or solve. A successful student will practice pushing through this resistance and will develop some comfort with and appreciation for this process.
2. **Ability to abstract.** In this course, we'll see how to group together similar ideas into categories that can be generalized into more abstract concepts. A successful student will have practiced understanding the material of the course using this type of higher-order thinking, rather than relying on memorization and recollection of facts.
3. **Ability to strategize.** A successful student will practice identifying possible approaches to problems they are unable to solve and will learn how to recognize what information or roadblocks are preventing them from pursuing this approach.
4. **Thinking for oneself.** A successful student will learn to be comfortable approaching problems they have never seen before by using their own ideas and creativity, rather than relying on a predetermined outline or algorithm.
5. **Appreciation for learning.** The material we'll learn in this course is widely applicable, but many of the discoveries we'll encounter arose independent of these applications. A successful student will practice viewing the process of learning and the study mathematics as a human act akin to an art with its own inherent value.

Weekly Schedule and Dates

Weekly Schedule: Unless otherwise specified, our weekly schedule will be as follows. Note that we meet as a class in Doherty on Monday, Wednesday and Fridays, and you meet in your individual recitation sections on Thursdays.

Day	Agenda
Mondays	In-class activity Lecture Concept Quiz due by 11:59pm
Wednesdays	In-class activity Lecture Concept Quiz due by 11:59pm
Thursdays	Recitation Worksheet (even-numbered weeks) Exam Prep Assessment (odd-numbered weeks)
Fridays	In-class activity Lecture Concept Quiz due by 11:59pm Homework due by 11:59pm (even-numbered weeks)

Important Dates: Here are some dates you may want to keep in mind:

Tues Jan 17:	Classes begin
Mon Jan 30:	Add deadline
Mon Feb 27:	Drop deadline (W assigned after this date)
March 6-10:	Spring break (no classes)
March 13-15:	Spring carnival (no classes)
Mon April 3:	Withdraw deadline
April 17-21:	Fall registration week
Fri April 28:	Last day of classes

See the [CMU academic calendar](#) for a full list of dates.

Assessment and Grades

There are five basic kinds of graded work you will be doing: concept quizzes, homework assignments, worksheets, exam prep assessments, and the final exam. Details and weights for each of these components can be found below.

Concept Quizzes (10%): Concept quizzes will be assigned on **Canvas** at the beginning of each week and are meant to test your understanding of material from the corresponding day's activity. You are welcome to complete concept quizzes during lecture time.

Details and Policies:

- Unless otherwise indicated there will be three concept quizzes each week, which must be completed on Canvas by 11:59pm each Monday, Wednesday, and Friday.
- Each quiz will **require a password** to access, which I will provide during the corresponding day's activity. Please see the [Course Policies](#) section for what to do if you are absent.
- You are welcome to use whatever resources you would like to complete the concept quizzes.
- I will drop your **lowest six** concept quiz scores.

Homework (20%): Homework will be posted on the course webpage and collected on **Gradescope**, generally during Fridays of **even numbered weeks** of the semester. Homework assignments will contain the most challenging problem you'll see in the course and will help you dive deeper into the course material. I strongly suggest you start assignments well before the due date so that you have time to get stuck, attend office hours, and put together your final work professionally.

Details and Policies:

- Work must be presented professionally and legibly. If we cannot read your work or struggle to follow your reasoning, we will not grade the problem. I suggest reviewing [this resource](#) on writing mathematics well.
- Assignments must be carefully scanned and uploaded to Gradescope no later than the indicated time. There will be no exceptions for technology issues, so I suggest you upload your homework at least one hour before the deadline.
- Length of homework assignments will be based on material covered in lecture. It is likely we will not be able to grade every problem you submit. We will choose a random selection of representative problems to grade after the due date. You should complete each problem that is assigned as if it were going to be graded.
- Homework will generally be returned to you on Gradescope within one week of submission. Late work will not be accepted without a verifiable excuse (e.g. a doctor's note).
- Regrade requests will be due one week after grades are released (see the [Course Policies](#) section for details about regrade requests).
- I will drop your **lowest two** homework scores.

Worksheets (10%): Worksheets will be assigned in Thursday's recitation during **even-numbered weeks** of the semester. Worksheets are meant to be a low-pressure way for you to engage with the material before you complete your homework, and are meant to help you practice for the following week's exam prep assessment.

Details and Policies:

- You will be given a packet of problems to complete with around 3-4 of your peers during your recitation section.
- Attendance and participation will be considered during recitation meetings, and will contribute to your overall worksheet score.
- To earn full participation points, you are expected to spend the majority of recitation time working diligently with your group. Note that these worksheets are intended to be a group effort. I expect groups to engage in regular discussion. I also expect you to show kindness and respect to your group mates. Our goal should be to cultivate an inclusive and safe environment so that everyone can participate and contribute to the conversation.
- Worksheets will be collected at the end of your recitation section each Thursday and will be graded on completion only.
- I will drop your **lowest two** worksheet scores.

Exam Prep Assessment (20%): During Thursday's recitation in **odd-numbered weeks** of the semester, you will be given a short problem set to complete on your own during recitation, which will be graded similar to an exam. The goal of these short assessments is to keep you current with material throughout the course, and to give you practice solving new problems on your own under some time pressure in order to prepare you for the final exam.

Details and Policies:

- Each assessment will be written to take about 30 minutes, but you will be given the full 50 minutes of recitation to complete them.
- You are allowed a full page of notes (front and back) for all exam prep assessments.
- Each assessment will only cover new material from the previous two weeks of the semester. I suggest you review the previous week's worksheet, homework, lecture activities, lecture notes, and concept quizzes to prepare.

- Your assessments will be scanned and graded by the course TAs using Gradescope.
- Regrade requests will be due one week after grades are released (see the [Course Policies](#) section for details about regrade requests).
- I will drop your **lowest two** exam prep scores.

Final Exam (40%): The final exam will take place during the week of May 1st, and will cover all material from the semester. Details about the format and material for the final exam will be provided during the last week of classes. The final exam schedule will be released sometime in mid-semester. If you need to make travel arrangements before the exam schedule is released, I suggest you schedule your departure on or after May 9th. Note that **I will not provide makeup exams to accommodate your travel schedule.** If you cannot attend the final exam due to scheduling your departure before our scheduled exam date, you will receive a zero on the exam.

University Grading Standards: Final grades will be assigned using a standard grading scheme. Grading in this course is designed to meet the [CMU grading standards](#). Final grades, with the standard grading option for the course, will be awarded as follows:

Grade	Percentage	Standard
A	$\geq 90\%$	Excellent
B	[80%, 90%)	Good
C	[70%, 80%)	Satisfactory
D	[60%, 70%)	Passing
R	$< 60\%$	Failure (retake)

Unless otherwise stated, I will not be planning to curve the course.

Course Policies

Anonymous Grading: All graded work in the course will be done blindly (with the help of Gradescope) to help account for grader bias. Please do not put any identifying information on your homework assignments, and please only write your name and Andrew ID on exams and exam prep assessments in the indicated area.

Absences and Late Work: Due to the size of our course, I will not be accepting any late work or allowing for makeups in the course. Note that I drop a number of assignments from each category of graded work for the course to account for any absences (see the [Assesment and Grades](#) section for details). **Additional exceptions will only be made with a verifiable excuse**, such as a doctor's note or a positive covid test. If you need to miss a day and have a verifiable excuse, please do the following **before the scheduled lecture or recitation time:**

1. If you are absent on a lecture day, please send Dr. Bellah an email to request the day's activity and lecture recordings. You will be given some extra time to complete the associated Canvas quiz.
2. If you are absent from your recitation on a Worksheet day, email Dr. Bellah with your verifiable excuse. Once the absence has been approved, you may then email pictures (AS A SINGLE PDF) of your work **to your recitation leader**.
3. If you are absent from your recitation on a exam prep assesment day, email Dr. Bellah with your verifiable excuse. Once it is approved, we will schedule a time for you to makeup the assesment, or excuse you from the assignment, depending on the circumstance.
4. If you need to miss the final exam, this must be communicated at least **one full day** before the scheduled exam. Depending on your circumstance (e.g. illness, family emergency, etc), I may offer to schedule a makeup exam for you. If you do not communicate this to me ahead of time, or I do not feel your excuse merits a makeup, you will receive a zero on the exam. Please give me as much notice as possible so that we can schedule a makeup or find an alternative solution.

Lecture Recordings: I will attempt to record lectures each day after our in-class activity. Keep in mind that the technology will likely fail some days, but I'll do my best. I will release lecture recordings and the previous week's activities to the "Pages" tab of Canvas on Monday of the following week.

Use of Resources: You are allowed to use whatever resources necessary to complete homework assignments and concept quizzes, but ultimately the work you submit must be your own. For example, if you lookup a homework solution, I expect you to rework the problem in your own words. **Any verbatim copying will be reported to the university as plagiarism.** If you are unsure if you've used a resource properly, please ask during office hour. Note that I strongly suggest you attempt every problem on your own first. Learning to consistently solve problems on your own is the most important thing you can do to prepare for exams, which are weighted much more heavily in this course than homework. If you rely too much on external resources to help you solve homework problems, you will not be prepared to solve problems on your own during in-class exams.

Regrade Requests: You may submit regrade requests for any assignment given during the semester. When submitting your request, please clearly indicate a justification for the regrade (e.g. points have been added correctly, mark does not match the rubric, etc). All regrade requests must be made on Gradescope ([here is a tutorial](#)) **within one week** of the assignment being returned to you.

Email: The instructor and TAs will respond to emails within three business days. If you do not receive a response within that time frame, please do follow back up (sometimes our inboxes get flooded and things get buried). Note that you should not expect responses to emails outside of normal working hours (around 9am to 5pm) or on weekends. All emails must be sent through your CMU email address.

Calculator Policy: Calculators will not be permitted on any of the exam prep assessments or on the final exam.

Additional Information

Student Academic Success Center: The SASC provides various programs to support student learning. Checkout the SASC's site (cmu.edu/student-success) for a full list of programs. In particular, I encourage you to consider their [peer tutoring](#). This is a tutoring service available to all CMU students at no additional cost.

Accommodations for Students with Disabilities: If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources (cmu.edu/disability-resources), I encourage you to contact them at access@andrew.cmu.edu.

Respect for Diversity: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you