

MTH/CMSE 314: Matrix Algebra with Computational Applications

Course Description

Historically, *Linear Algebra* was developed from studying methods for solving systems of linear equations. This course teaches core Linear Algebra concepts with a focus on applications encountered in science and engineering. These “real world” problems are often larger than what can easily be solved by hand, so this course focuses on ***numerical techniques for understanding and solving large systems of equations using computing***.

By the end of this course, you will be able to:

1. ***Demonstrate*** the ability to solve $Ax=b$ for linear systems, including underdetermined, invertible, and overdetermined systems.
2. ***Use*** the language of Linear Algebra to describe scientific problems (i.e., you will use terms like vector spaces, pivots, multipliers, column spaces, row space, null space, back substitution, invertibility of a matrix, etc. to describe problems in science.)
3. ***Define*** and ***Compute*** key vector and matrix properties (rank, dot product, dimensionality, singular values, identity, etc.)
4. ***Give examples and Use*** basic Elementary and Transformation Matrices.
5. ***Recognize*** the use of Eigenvalues and Eigenvectors and their role in problem-solving.
6. ***Explain*** Factorization and Decompositions.
7. ***Explain*** numerical complexity and ***Compare*** algorithms using Big-O notation.
8. Be able to ***Illustrate*** the differences between different Numerical approaches to solving large sets of linear equations.
9. ***Demonstrate*** the ability to write programs that can solve linear algebra problems.
10. ***Identify*** programming libraries and techniques to solve linear algebra problems.
11. ***Write*** programs to solve common Linear Algebra problems in a variety of scientific and engineering disciplines.

We will work toward the goals expressed above throughout this course using a range of activities – primarily by writing software both individually and in small groups, but also through discussion, presentations, and other types of exercises.

Topics Covered

The primary topics covered in this course include:

- Linear Equations and Vectors
- Matrices and Linear Transformations
- Determinants and Eigenvectors
- Vector Spaces and Subspaces
- Bases, Projections, and Orthogonality
- Numerical Methods for solving large scale problems

Please note that **using the language of linear algebra and computers to solve scientific problems** (whether they are problems in the physical, life, or social sciences, or in engineering) is the driving principle of this course – everything else we teach you is in service to this goal.

Course Format and Activities

Pre-class assignments

We will provide assignments, which are estimated to take up to 1 hour, before each class. The purpose of these assignments is to

1. Introduce new material and give you some exposure so that we can focus on hands-on practice during class.
2. Help inform instructors which topics should be emphasized during class

These assignments will typically consist of short videos, reading assignments, and related questions or problems. Each pre-class assignment includes a small D2L survey that students must fill out by **11:59PM (EDT)** the night before class to receive credit. The pre-class assignment will be graded on demonstrated effort, and the pre-class survey will be graded on completion. So, it is ok if you can't finish everything and/or do not understand all the pre-class material. However, providing instructors with feedback on which topics the class is struggling with is essential. So please take these assignments and surveys seriously. These assignments will account for 15% of the student's final grade. The 5 lowest pre-class assignment scores will be dropped to account for any and all special circumstances including: travel, family obligations, work, emergencies, illness, technology issues, University sanctioned events, and grief absences. No drops, extensions, or additional make-up opportunities can be granted.

In-class assignments

Each student is expected to submit an in-class notebook (via a D2L assignment dropbox) by **11:59PM (EDT)** on the corresponding class days. The in-class assignments will account for 15% of the student's final grade. Grading is based on attendance and making a good faith effort to complete the assignment in class. Students are expected to attend class and work with their peers to complete the in-class assignments, in order to receive credit for the assignment. The 5 lowest in-class assignment scores will be dropped to account for any and all special circumstances including: travel, family obligations, work, emergencies, illness, technology issues, University sanctioned events, and grief absences. No additional drops, extensions, or additional make-up opportunities can be granted.

Homework

You will have 5 homework assignments throughout the semester (approximately 1 assignment every 2-3 weeks) that will provide a more in-depth exploration of the materials covered in class. These assignments must be turned in by **10:00AM (EDT)** on their due date (found on D2L and the schedule) via a D2L assignment dropbox. Homeworks will account for 40% of the student's final grade and are graded based on correctness. It is important that you work ahead on these and do not wait until the last moment to submit them. There is always a chance that on the due date your wifi goes down, there is an emergency at work, etc.

Students who miss the homework due date for any reason may submit it

- within 24 hours of the due date/time but with a 20% penalty.
- within 72 hours of the due date/time but with a 50% penalty.

This late submission policy is meant to account for all travel, family obligations, work, emergencies, illness, and technology issues. No drops, extensions, or additional make-up opportunities can be granted. Students with extreme situations or University sanctioned events should contact their instructor.

Quizzes

You will have 4 quizzes throughout the semester (approximately 1 quiz every 2-3 weeks) that are designed to assess your current understanding of the course materials. Together they will make up 20% of your course grade. The quizzes will be administered during each section's regularly scheduled class time on the dates shown below.

Quiz#	Sections 3 and 4	Sections 1, 2, and 5
Quiz 1	Wed 9/28	Thu 9/29
Quiz 2	Wed 10/12	Thu 10/13
Quiz 3	Wed 11/02	Thu 11/03
Quiz 4	Wed 11/16	Thu 11/17

Students may only use their computer to access the quiz on D2L as well as to use the provided Python compiler to execute code. Students may not use their computer to access files, notes, class assignments, access websites (other than D2L), or communicate with other people. Students are free to use blank scrap paper and a writing instrument during the quizzes. No other devices/materials are permitted.

Students in Sections 1-4 are expected to take the quiz in-person unless they have an instructor approved reason to take the quiz remotely. Students in Section 5 will have to take the quiz remotely since that section meets online. Students taking the exam remotely will be required to be on Zoom, have their camera on, and be ready to share their screen and/or turn on their microphone when requested by a proctor. Students who cannot take a quiz with their section should contact their instructor to discuss makeup arrangements.

Final Exam

The final exam is 2 hours long, will have a similar format to the Quizzes, will be proctored in a similar way, and will have similar material restrictions. The university determines the final exam schedule (here is the [full university final exam policy](#)). The Final Exam is cumulative and will account for 10% of a student's grade. The final exam times for each section are:

- Section 1: TBD
- Section 2: TBD
- Section 3: TBD
- Section 4: TBD
- Section 5: TBD

Extra Credit

There are exactly two extra credit opportunities in this course. They are two “round-up” surveys during the semester to help the department gain a better understanding of its student population. The pre-course survey must be completed by **Friday, September 9th**. The post-course survey will be available during the last week of class. The URL to the surveys will be posted on D2L when available. No extensions can be provided on these surveys. Each completed survey contributes at least 0.5% to the overall course grade. These surveys are made to help round up any students who are close to the next grade threshold. There is no additional rounding beyond

this. Individual instructors do not have the capabilities of creating additional extra credit opportunities as all students need to have the same opportunities.

Example: Suppose your course grade is 89.2% which is a 3.5. By doing both of the course surveys this would be rounded up to a 4.0. Note: doing only one of the surveys would only round up 0.5% so would not be enough to guarantee a 4.0.

Assessment Information

There are a variety of course activities, with percentages of total grades listed. More detailed descriptions of each activity can be found in the corresponding syllabus sections above.

Activity	Grade Percentage
Pre-Class Assignments (drop 5 lowest)	15
In-Class Assignments (drop 5 lowest)	15
Homework Assignments	40
Quizzes	20
Final Exam	10
Total	100

Grading scale

Percent Grade	4.0 Grade
[90,100]	4.0
[85,90)	3.5
[80,85)	3.0
[75,80)	2.5
[70,75)	2.0
[65,70)	1.5
[60,65)	1.0
[0,60)	0.0

Note: grades **will not be curved** - your grade is based on your own effort and progress, not on competition with your classmates.

Course Meeting Time and Location

Class sessions will be held twice a week and broken up into presentations, discussions, and programming activities that will allow you to immediately implement (and get instant feedback on) what you have just learned. Students are expected to attend class and work together with fellow students and the instructors/TAs.

Students are expected to attend their class for their own sections and will not be allowed in during other classes without both instructors' prior approval.

- Section 1 - TR 10:20am-11:40am in Natural Sciences Building Room 304
- Section 2 - TR 12:40pm-2:00pm in Engineering Building Room 2400
- Section 3 - MW 10:20am-11:40am in Holden Hall Room C131
- Section 4 - MW 12:40pm-2:00pm in-person, location TBD
- Section 5 - TR 12:40pm-2:00pm on Zoom (link TBD)

Course Schedule

The course schedule is maintained through the [schedule document](#) in D2L **THIS LINK WILL BE UPDATED ONCE D2L SITE IS UP.**

Important University dates (such as enrollment periods, last date to drop the class with no grade reported, and school holidays) are maintained at <https://reg.msu.edu/ROInfo/Calendar/academic.aspx>

How To Get Help

Piazza

We will be using Piazza as our means of communicating outside of scheduled class times about course content as the semester progresses and you are expected to monitor Piazza regularly. We believe that this will provide an excellent avenue to have discussions not only with course instructors, TAs, and LAs, but also between you and your fellow classmates. You can enroll in our class on Piazza via [this link](#)

In order to ensure that Piazza is an appropriately used tool that does not become overly time-consuming for the course instructors, TAs, or LAs, we have a list of rules for how we expect you to use Piazza. They are:

1. Before you ask a question, be sure to do a quick search to see if the question has already been answered.
2. The Piazza forum is primarily for you, the students, to help each other.
3. The TAs and ULAs will monitor Piazza, but will defer to the students to work through things. They will only enter a conversation if students are going down the wrong path and/or there are too few other students involved. However, you should not expect that the TAs or ULAs will always be available.
4. Piazza is meant to be used to help you when you are stuck with a minor issue. If you are having major issues or trouble understanding the concept, go to office hours or a help session. Office hours and help sessions are meant for more in-depth discussions of course content.

5. Only in very rare cases should you contact an instructor through a private channel. But, if you are struggling, feel free to use this option.
6. Do not post your solutions to assignments directly into Piazza unless prompted by an instructor. We expect you to adhere to MSU's academic integrity policy and honor code.
7. Be courteous to everyone on Piazza.

Help Room

This semester, the CMSE/MTH 314 Help Room (think free tutoring / office hours) will be open:

DAYS AND TIMES TO BE DETERMINED

The Help Room will be run via Zoom (link TBD).

Contact Your Instructor

Questions, which are more personal, for example concerning a student's grade, accommodations, etc. should be addressed to the instructor(s) of the student's specific section. You may email your section's instructor, and if necessary, set up a time to talk privately. Note that this is not meant for questions about the course material.

Other Resources

[MSU Counseling Center](#)

[Student Resources](#)

[Resource Center for Persons with Disabilities](#)

Required materials for class

Whether your section meets in-person or virtually, the "in-class" programming assignments are a critical part of the learning process in this course.

Pre-class assignments, in-class assignments, homework, quizzes, and the final exam will all be submitted through D2L. The quizzes and the final exam will be on D2L. In the event that you need to take a quiz or the final exam remotely, you will be required to be on Zoom to be proctored. To that end, you will need to ensure that you have the following:

- A computer with a reliable internet connection, webcam, microphone and speakers.
- The ability to run the Zoom video conferencing software, which you can download here: <https://msu.zoom.us/support/download>

If you do not have a sufficiently reliable internet connection, you should notify your instructor immediately to determine how you can best participate in the course and successfully complete the required activities.

Reading Materials

Student self-guided learning through assigned readings is required for students to be successful. The course strives to use Open Educational Resources (OER) to help reduce student financial burden. To this end, we have selected the following downloadable textbooks for reading assignments and supplemental examples:

- [Introduction to Applied Linear Algebra by Boyd and Vandenberghe](#)
- [Linear Algebra by Jim Heffron](#)
- [A First Course in Linear Algebra by Robert A. Beezer](#)

Instructional Team Contact Information

Instructor/TA/LA Emails

- Section 1
 - Instructor: Santhosh Karnik -- karniksa@msu.edu
 - TA: Leonard Korreshi -- korreshi@msu.edu
 - LA: Jessica Messing -- messin81@msu.edu
 - LA: Jared Bloch -- blochjar@msu.edu
- Section 2
 - Instructor: Yingda Cheng -- ycheng@msu.edu
 - TA: Son Tu -- tuson@msu.edu
 - LA: Dan Le -- ledan3@msu.edu
 - LA: Avi Lochab -- lochabav@msu.edu
- Section 3
 - Instructor: Jiahui Chen -- chenj159@msu.edu
 - TA: Bowen Su -- subowen@msu.edu
 - LA: Ishita Kokil -- kokilish@msu.edu
 - LA: Kollin Michael Bartz -- bartzkol@msu.edu
- Section 4
 - Instructor: Alexei Bazavov -- bazavov@msu.edu
 - TA: Christopher Matthew Grow -- growchri@msu.edu
 - LA: Rajmeet Chandok -- chandok1@msu.edu
 - LA: Nandini Tengli -- tenglina@msu.edu
- Section 5
 - Instructor: Craig Paul Gross -- grosscra@msu.edu
 - TA: Rishabh Sareen -- sareenri@msu.edu
 - LA: Ayaan Shaik -- shaikaya@msu.edu
 - LA: Ryan Kunkle -- kunkelry@msu.edu

Communication with Instructors/TAs/LAs

Most instructors/TAs/LAs prefer to be contacted via email or via Piazza. Instructors will strive to respond to emails and Piazza posts within one business day but may not respond if

- they already addressed or are planning on addressing the question/issue in class to everyone, or
- if the answer is available on the syllabus/course website.

Therefore, it is a good idea to check the syllabus and course website before emailing your instructor!

Questions that concern the course content or otherwise may be relevant to everyone should be posted on Piazza. Questions, which are more personal, for example concerning a student's grade, accommodations, etc. should be addressed to both recitation instructors of the student's specific section.

Course Policies and Expectations

Course Announcements

Important course announcements will be posted to the D2L "Announcements" widget on our homepage. You are responsible for reading these announcements within 24hrs (so check our D2L page at least once per day!)

Inclusive classroom behavior

Respectful and responsible behavior is expected at all times, which includes not interrupting other students, refraining from non-course-related use of electronic devices or additional software during class sessions, and not using offensive or demeaning language in our discussions. Flagrant or repeated violations of this expectation may result in ejection from the classroom, grade-related penalties, and/or involvement of the University Ombudsperson. In particular, behaviors that could be considered discriminatory or harassing, or unwanted sexual attention, will not be tolerated and will be immediately reported to the appropriate MSU office (which may include the MSU Police Department).

In addition, MSU welcomes a full spectrum of experiences, viewpoints, and intellectual approaches because they enrich the conversation, even as they challenge us to think differently and grow. However, we believe that expressions and actions that demean individuals or groups comprise the environment for intellectual growth and undermine the social fabric on which the community is based. These demeaning behaviors are not welcome in this classroom.

COVID-19 Related Policies

FILL THIS IN

Instructor illness

Given the uniform nature of the course, if an instructor becomes sick, his or her duties will be covered by one of the other team members, so no lapse in instruction is anticipated to occur. If there are any changes to our teaching roster, students will be notified via email and D2L announcement.

Other Course Policies

There are many other important course policies that apply to our class here:

https://math.msu.edu/Classes/other_policies.aspx

Changes to Syllabus

The syllabus may also be adjusted if needed. Such changes will be announced during class and on the course's Desire2Learn page (in the Announcements).