

Linear Algebra for Data Science and Engineering
M491 Section 01 (77123)
Fall 2024

Time: **1:00pm-2:15pm MW**

Room: **SEB 308**

Course Description: This course will focus on understanding how linear algebra, in the form of matrices, can be used to efficiently process, represent, approximate, visualize, and compute with data in the sciences and engineering. (See tentative daily schedule for further details)

Prerequisites: Permission from instructor

Co-requisites: There are no co-requisites

Learning Outcomes:

- Looking at the world of data through matrices
- Formulating and solving problems involving large data sets with the help of matrices
- Thinking and expressing ideas in the language of matrices
- Learning how ideas from linear algebra give rise to learning algorithms
- Knowing how computations are done with very large matrices

Course Page: linalg.mathematics.land, user id = 24fall, pwd =DatsGo0D!

Textbooks: Suggested references will be given out in class

Instructor: Atish J Mitra (email: amitra@mtech.edu)

Office Hours (MUS 203): 12:00am-12:45pm MW, or by appointment. Please send me an email if you need to meet at any other specific time.

Attendance Policy: Regular attendance is strongly recommended.

Grading Policy: There will be multiple homework sets to be turned in (25% total), two take-home exams / projects (25% each) and an hourlong in-class exam (25%). I do not grade on a curve, and do not assign individual extra credit assignments. Your grades will be independent of how the rest of the class performs.

Grading Scale:

	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
	93-	90- 92	87- 89	83- 86	80- 82	77- 79	73- 76	70- 72	67- 69	63- 66	60- 62	0- 59

Academic integrity:

A zero-tolerance policy will be enforced for academic dishonesty / cheating. Academic dishonesty / cheating includes plagiarism on homework or other assignments, copying from or deliberately aiding another student during quizzes / exams, using unauthorized books, notes, calculators or other computing devices, using cell phones, pagers, Apple/Android watches or any other communicating devices during quizzes / exams.

Any student who is found to have cheated on a homework / quiz / exam will receive a penalty (at the discretion of the instructor) ranging from a 0 in that particular homework / quiz / exam to a grade of F in the course. Moreover, the incident of academic dishonesty will be reported to the office of the Provost/Vice Chancellor for Academic Affairs.

You should carefully read Montana Tech's academic dishonesty policies. It is available in the student handbook, which can be found following the link:

https://www.mtech.edu/student_life/student-handbook.pdf

The instructor reserves the right to assign seating arrangements or change a student's current seating arrangement before or during any quiz or exam.

Policy on Generative AI:

While you are encouraged to experiment with Generative AI, be aware that you are not allowed to use such resources for homework and take-home exams for this class. The reason for this policy for our class is that the use of generative AI for mathematics problems often produce incorrect solutions or solutions with incorrect reasoning, and therefore does not help in learning the material.

Miscellaneous Policies:

1. Check Moodle for announcements and other notes regularly. HW assignments will be posted on Moodle. Moodle will be used in this course only to record your scores on quizzes or exams, and not to calculate the course grade. Course grade will be calculated at the end of the semester as per “grading policy” given above. If Moodle lists a column marked “total score” (or something similar), please ignore it.
2. Please do not hold conversations, either with your classmates or through your cell phones, during the lecture. Cell phones/pagers must be put on silent at all times. No texting during class.
3. All unauthorized recordings of class are prohibited. Recordings that accommodate individual student needs must be approved in advance and may be used for personal use during the semester only.
4. It is your responsibility to check all your grades on Moodle before the final exam date and report me in writing if your grades are recorded incorrectly. You should keep all your graded exams/quizzes/classwork/homework until you receive your final course grade.
5. **Special Accommodations:** If you qualify for special accommodations and would like to avail of it, please send me an email to set up an appointment ASAP. When you come for your appointment, please have a letter from your Tech Counselor available.
6. **Emergency Evacuation Procedure:** See university webpage and emails.

Tentative Daily Schedule			
Day	Date	Remark	Topic
1	26-Aug		Matrices and Basic Operations - calculations with matrices
2	28-Aug		Matrices and Basic Operations - calculations with matrices
	2-Sep	Labor Day	NO CLASS
3	4-Sep		Systems of Linear Equations - Motivation and matrix forms
4	9-Sep		Systems of Linear Equations - Gaussian Elimination
5	11-Sep		Systems of Linear Equations - Gauss Jordon, Matrix Inverse
6	16-Sep	Last Drop Date	LU Factorization
7	18-Sep		LU Factorization
8	23-Sep		Vector spaces: Vector spaces and subspaces
9	25-Sep		Vector spaces: linear combinations, linear independence, span
10	30-Sep		Vector spaces: Column and Null space
11	2-Oct		Vector spaces: Solutions of linear systems revisited
12	7-Oct		Bases and Orthogonality: Basis and Dimension, orthogonality
13	9-Oct		Bases and Orthogonality: Gram-Schmidt and QR
14	14-Oct	AI Workshop @ Mtech	Least Squares: Loss function and Normal form
15	16-Oct		Least Squares: Unique solution vs Non-Unique solution
16	21-Oct		Least Squares: Application 1
17	23-Oct		Eigenvalues and Eigenvectors: Basics
18	28-Oct		Eigenvalues and Eigenvectors: Algorithms for finding eigenvalues
19	30-Oct		Eigenvalues and Eigenvectors: Diagonalization
20	4-Nov		Eigenvalues and Eigenvectors: Application 1 Dynamical Systems
21	6-Nov		Eigenvalues and Eigenvectors: Application 2 PageRank
22	11-Nov		Low Rank Approximations
23	13-Nov		Low Rank Approximations : Application 1
24	18-Nov		SVD
25	20-Nov		SVD
26	25-Nov		SVD : application 1 - Image Compression
	27-Nov	Thanksgiving Break	NO CLASS
27	2-Dec		SVD: application 2 - PCA
28	4-Dec		Summing Up