ILLINOIS

Math 257: Linear Algebra with Computational Applications

Offered through NetMath

Academic Year 2026-2027 Term, 16-week course

Instructor Information

Instructor – ***Tayyab Nawaz***

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- Office hours by appointment.

Course Information

Credit Hours

3 credit hours

Course Description

MATH 257 is a rigorous, application-driven introduction to linear algebra that bridges classical theory with modern computational practice. Students develop a deep understanding of the mathematical structures underlying linear systems, vector spaces, and matrix factorizations, and learn to apply these ideas to real-world problems in data science, engineering, and scientific computing. The course integrates Python-based computation throughout, building both mathematical intuition and practical programming fluency. Key topics include systems of linear equations, matrix operations and factorizations (LU, QR, SVD), vector spaces and linear transformations, eigenvalues and diagonalization, orthogonal projections and least squares, and dimensionality reduction via Principal Component Analysis.

Prerequisite

MATH 220 or MATH 221; CS 101.

Course Objectives:

Upon successful completion of this course, students will be able to:

1. Solve systems of linear equations using matrix methods and Gaussian elimination.
2. Interpret matrices as linear transformations and understand matrix multiplication as composition of transformations.
3. Analyze vector spaces, subspaces, linear independence, bases, and dimension.
4. Compute matrix factorizations including LU decomposition.
5. Compute eigenvalues and eigenvectors and apply matrix diagonalization.
6. Apply orthogonality concepts such as projections and Gram–Schmidt orthogonalization.
7. Formulate and solve least squares problems and perform linear regression.
8. Model graphs and Markov chains using linear algebra methods.
9. Apply singular value decomposition and principal component analysis to data.
10. Implement linear algebra algorithms in Python using industry-standard libraries.

Course Content:

1. **Linear systems and matrix algebra:** Introduction to linear systems, matrix representations, row operations, echelon and reduced echelon forms, Gaussian elimination, linear combinations, matrix-vector multiplication, matrix-matrix multiplication, properties of matrix multiplication.
2. **Matrix invertibility and factorization:** Elementary matrices, matrix invertibility criteria, computing the matrix inverse, LU decomposition, solving linear systems via LU decomposition.
3. **Vector spaces and subspaces:** Inner products, orthogonality, subspaces of $\mathbb{R}^n$, column space, null space, abstract vector spaces, linear independence, basis, dimension, the four fundamental subspaces.
4. **Orthogonality and linear transformations:** Orthogonal complements, coordinates and change of basis, orthogonal and orthonormal bases, linear transformations, matrix representations of linear transformations.
5. **Determinants:** Definition and properties of determinants, cofactor expansion, applications to invertibility.
6. **Eigenvalues, eigenvectors, and diagonalization:** Computing eigenvalues and eigenvectors, characteristic polynomial, properties of eigenvectors, Markov matrices, diagonalization, powers of matrices, matrix exponential.
7. **Orthogonal projections and least squares:** Orthogonal projections onto lines and subspaces, least squares solutions, linear regression, Gram-Schmidt orthogonalization process, Spectral Theorem.
8. **Singular value decomposition and applications:** Singular Value Decomposition (SVD), low-rank matrix approximation, pseudo-inverse, Principal Component Analysis (PCA).

9. **Complex linear algebra:** Review of complex numbers, complex vector spaces, Hermitian matrices, complex eigenvalues and eigenvectors.

Course Structure:

This course is fully online and asynchronous. Students have 16 weeks from their course start date to complete the course. The course is self-paced, and students may complete their coursework prior to the assigned end date. However, students are encouraged to follow the guided structure provided by the instructor with suggested deadlines for assignments and exams. As this is a 3-credit hour course, students are expected to dedicate 9 hours per week to learning course content.

The course expects students to complete roughly one unit per week across the 16-week self-paced period. Assessments include quizzes (6%), computer lab homework (10%), PrairieLearn homework (12%), three midterm exams (18% each), and a final exam (18%), with all exams proctored online through ProctorU Record+.

Course Platforms:

Platform	Description
Canvas	Course materials, announcements, grades, and lecture notes
PrairieLearn	Homework assignments, quizzes, and computational exercises
Python	Computational labs no local installation required; browser-based environment provided
ProctorU	All exams administered online via ProctorU Record+

Course Schedule:

Week	Quiz	Homework	Lab	Notes
Week 1	Q1	HW 1	Lab 1	
Week 2	Q2	HW 2	Lab 2	
Week 3	Q3	HW 3	Lab 3	
Week 4	Q4	HW 4	Lab 4	*Midterm Exam 1 (Weeks 1–4)*
Week 5	Q5	HW 5	Lab 5	
Week 6	Q6	HW 6	Lab 6	
Week 7	Q7	HW 7	Lab 7	
Week 8	Q8	HW 8	Lab 8	*Midterm Exam 2 (Weeks 5–8)*
Week 9	Q9	HW 9	Lab 9	
Week 10	Q10	HW 10	Lab 10	
Week 11	Q11	HW 11	Lab 11	
Week 12	Q12	HW 12	Lab 12	*Midterm Exam 3 (Weeks 9–12)*
Week 13	Q13	HW 13	Lab 13	
Week 14	Q14	HW 14	Lab 14	
Week 15	–	–	–	*Review*
Week 16	–	–	–	*Final Exam (Comprehensive)*

Exams:

Each of the three midterm exams has a 55-minute time limit; the comprehensive final exam is 3 hours.

All exams will be administered online, free of charge to students. Exams are administered using ProctorU Record+. More information on taking exams.

Calculators are not permitted or required for NetMath exams.

The use of outside sources is prohibited.

Refer to the Academic Integrity policies below in the syllabus for more details.

Scratch paper is allowed during exams.

Exams must be taken in course order.

Grading:

Grading Breakdown:

Component	Weight
Computer Lab Homework	7%
PrairieLearn Homework	10%
Quizzes	8%
Exam 1	15%
Exam 2	15%
Exam 3	15%
Final Exam	30%

Letter Grade Scale:

Percentage	Letter Grade
97 - 100	A+
93 - 96	A
90 - 92	A-
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
67 - 69	D+
63 - 66	D
60 - 62	D-
59 and below	F

Final grades are rounded to the nearest integer before applying the scale above.

Grades are not curved.

Once you complete your exam, you will receive a 0 on any homework leading up to that exam that has not been submitted. Under special circumstances, students may request that they be allowed to submit these assignments. This is left to the discretion of the course instructor.

Students are encouraged to follow the guided deadlines in their course. However, as our courses are self-paced, students may occasionally submit several assignments in a short period of time.

Due to the rolling enrollment structure of the NetMath program, instructor workloads vary throughout the year. During peak periods, response times may be longer than usual. Students should expect significant delays in instructor responses between June and August.

Communication:

Students are encouraged to post course-related questions on the Canvas forum, so all students can benefit from the responses, and it fosters a collaborative learning environment. For private or personal matters, students can contact the instructor directly via email, with a response time of 2–3 business days.

If you experience consistent and significant delays in reaching your instructor, please contact instruction@netmath.illinois.edu with your concerns.

If you have non-course specific questions, you may reach out to the NetMath office. It is recommended to review the NetMath website first as it often has the answers you need.

General Inquiries: netmath@illinois.edu

Proctoring Questions: proctor@netmath.illinois.edu

Technology Questions: tech-staff@netmath.illinois.edu

Main Office Phone: (217) 265-0439

Phone hours: Monday - Friday, 9am - 12pm & 1pm - 4pm CST

Textbook:

There is no required textbook. All lecture notes, readings, and reference materials are provided through Canvas. Students who wish to supplement their learning may find the following resources helpful:

– Introduction to Linear Algebra by Gilbert Strang (MIT OpenCourseWare lecture videos freely available at ocw.mit.edu)
– Linear Algebra and Its Applications by Lay, Lay, and McDonald
– Python documentation for NumPy (numpy.org) and SciPy (scipy.org)

Technical Requirements:

Students are expected to have a device with an up-to-date operating system to access their course materials, reliable internet access, and must meet the requirements set by ProctorU for exam proctoring. NetMath IT - Frequently Asked Questions.

Other Information:

This course is adapted from the UIUC Spring 2021 course taught by Professor Philipp Hieronymi.

Policies:

Accommodations:

The University of Illinois Champaign-Urbana, is committed to ensuring that all students, including students with disabilities, do not experience barriers to learning and participating fully in class. Students who have a letter of accommodation from DRES are advised to share that with their instructor and NetMath staff at instruction@netmath.illinois.edu as soon as possible to ensure accommodation needs can be discussed and met.

Students enrolled in a degree program at another institution may refer to their home institution's student services or disability office for accommodations. Current, non-expired documentation from other institutions listing the specifics of an accommodation is acceptable and should be sent to instruction@netmath.illinois.edu.

To obtain disability-related academic accommodations, disabled students must contact Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, please visit 1207 S. Oak Street, Champaign, call (217) 333-1970, email disability@illinois.edu, or visit the DRES website.

Academic Integrity:

The University of Illinois Urbana-Champaign *Student Code* (https://studentcode.illinois.edu/) should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy (https://studentcode.illinois.edu/article1/part4/1-401/). Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

AI Large Language Models (such as ChatGPT, Claude, Gemini, etc.) are prohibited during exams. Using these during the exam will be considered a violation of academic integrity and may incur sanctions as outlined in the Illinois Student Code. Students should be aware the exam proctoring process involves screen recording of the computer. While AI will not be strictly prohibited for homework as they can be useful tools for studying and brainstorming, students are strongly encouraged to work on the homework themselves or collaborate with peers when appropriate. Students are required to submit their own work and answers. This improves learning outcomes and best prepares students for exams. Homework is designed to help students understand the content and develop skills. Students may be unprepared for exams if there is heavy reliance on AI.

Students are expected to follow the University guidance on intellectual property. Students are not to share course content outside of the course.

Campus Holidays:

Instructors are expected to respond to student communications and grade homework assignments in a timely manner. Observed Campus Holidays, illness, personal obligations, or other circumstances outside the instructor's control may affect normal grading and response time. If you experience consistent and significant delays, please contact instruction@netmath.illinois.edu with your concerns.

Extensions:

Students in this course are eligible for up to two 1-month course extensions. There is a non-refundable $350 fee for each approved extension. Students should review the extension guidelines for more information.

FERPA:

See FERPA – Office of the Registrar (https://registrar.illinois.edu/academic-records/ferpa/) for more information on the Family Educational Rights and Privacy Act (FERPA).

Any student who has suppressed their directory information pursuant to FERPA should self-identify to the instructor to ensure protection of the privacy of their attendance in this course.

Mental Health:

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Health Service Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

Counseling Center or (217) 333-3704

McKinley Health Center or (217) 333-2700

National Suicide Prevention Lifeline or (800) 273-8255

Rosecrance Crisis Line or (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

*This statement is approved by the University of Illinois Counseling Center

Sexual Misconduct Reporting Obligation:

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including supportive measures, resources, the campus disciplinary process, and law enforcement options.

Designated Confidential Employees: A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality.

Other information about resources and incident reporting.