



EE 510: Linear Algebra for Engineering

Units: 4

Spring 2024

Lecture: Tue Thu—1200-1350

Discussion: Fri --- 1400-1550

Location: OHE 122 & DEN

Instructor: Dr. Ketan Savla

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Office Hours: Thursday 1600-1800, or by appointment

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Teaching Assistants:

Aolin Feng

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Course Description

Review of matrix analysis and elementary linear algebra; inner product spaces and norms; linear independence, basis, dimension, change of basis; solutions to linear equations; Gaussian elimination and LU factorization; fundamental subspaces of matrices; eigenvalues and eigenvectors; determinant; power iteration method; similarity transformations and diagonalization; Jordan canonical form; normal matrices; symmetric and sign-definite matrices; quadratic forms; singular value decomposition and matrix approximations; induced matrix norms; least-squares and least-norm problems; introduction to optimization; gradient descent and Lagrangian-based methods; linear programming; introduction to linear dynamical systems and state-space methods; additional applications.

Learning Objectives

The intent of this course is to provide the students with the working knowledge of advanced linear algebra and matrix theory.

Prerequisite(s): Prior courses in multivariate calculus and linear systems.

Corequisite(s): None

Concurrent Enrollment: None

Course Notes

Lecture notes and other relevant class information will be posted on the Desire2Learn system.

Technological Proficiency and Hardware/Software Required

Basic computer skills (e.g., plotting, Matlab, Python, etc.).

Required Readings and Supplementary Materials

[S] Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Thomson Learning Co., 2006.

Please refer to <https://viterbi-web.usc.edu/~mihailo/courses/ee510/s19/resources.html> for additional resources and supplementary materials.

Description and Assessment of Assignments

Moderate collaboration with classmates is encouraged. However, you will not be able to learn the material unless you invest enough time alone to understand each homework problem, and independently write the solutions that you turn in. Homework will be generally handed out every other Thursday, and it will be due at the beginning of the class one week later. **Late homework will not be accepted.**

Homework solutions should be typed or scanned using scanners or mobile scanner applications like CamScanner and uploaded on the DEN course website (photos taken by cell-phone cameras and in formats other than pdf will NOT be accepted). Programs and simulation results have to be uploaded on the DEN course website as well.

Grading Timeline

One week after submission.

Additional Policies

Attendance of the lectures is expected.

Grading Breakdown

Homework assignments	40 %
Midterm exam	30 %
Final exam	30 %

Course Schedule: A Weekly Breakdown

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1	Course mechanics; Overview of basic matrix manipulations; Linear independence	Homework 1 assigned	
Week 2	Basis; Range and null spaces; Linear equations; Fundamental subspaces; Fundamental Theorem of Linear Algebra		Homework 1 due
Week 3	Least squares problem; Least norm problem	Homework 2 assigned	
Week 4	Eigenvalue decomposition of a square matrix		Homework 2 due
Week 5	Determinants; Gaussian elimination; LU factorization; Diagonalization	Homework 3 assigned	
Week 6	Modal decomposition of LTI systems; Jordan canonical form		Homework 3 due
Week 7	Stability of LTI systems; Symmetric matrices; Quadratic form	Homework 4 assigned	
Week 8	Positive definite matrices; Matrix inner product; Matrix norm		Homework 4 due
Week 9	Singular value decomposition	Homework 5 assigned	Midterm tentatively on March 7 2024
Week 10	Spring Recess		
Week 11	Singular value decomposition (contd)		Homework 5 due
Week 12	Graph theory and linear algebra	Homework 6 assigned	
Week 13	Introduction to optimization		Homework 6 due
Week 14	Introduction to linear	Homework 7 assigned	

	programming; Linear & quadratic programs; Generalized least squares		
Week 15	Principal component analysis; Tensor networks		Homework 7 due
Week 16	Game theory and linear algebra		
FINAL	Final Exam		For the date and time of the final exam please consult the USC Schedule of Classes at classes.usc.edu . Tentatively 2pm-4pm on May 8 2024.

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services

(though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.