



East China Normal University
GEC International Summer School

MAT303: Linear Algebra

Term: June 16th to July 18th, 2025

Class Hours: Monday through Friday, 110 minutes each day (2,750 minutes in total)

Instructor: Mu He

Home Institution: Xi'an Jiaotong-Liverpool University

Office Hours: TBD

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Course Description

This course provides a comprehensive review and exploration of fundamental concepts in linear algebra, focusing on matrix algebra, determinants, systems of linear equations, vector spaces, linear operators, and their matrix representations. Students will delve into advanced topics such as orthogonality, eigenvalues, eigenvectors, and diagonalization of Hermitian matrices. Emphasis will be placed on understanding the theoretical foundations and practical applications of these concepts in various fields.

Prerequisite: MAT 21.

Course Objectives

Upon successful completion of this course, you should be able to:

- Manipulate matrices effectively and apply matrix techniques to solve complex problems in various domains.



- Analyze vector spaces and their properties, enabling them to apply these concepts in diverse mathematical and scientific contexts.
- Develop the ability to identify orthogonal structures and use orthogonal projections for applications such as least squares approximations and error minimization in data analysis and signal processing.
- Compute eigenvalues and eigenvectors, interpret their geometric and algebraic properties, and apply them to solve practical problems.
- Learn about the spectral theorem and how it relates to the diagonalization of Hermitian matrices.

Required Text

Schaum's Outline of Linear Algebra. 3rd Edition, by Lipschutz, Seymour; Lipson, Marc Lars. 2012.

ISBN: 9780980232776

Course Hours

The course has 25 class sessions in total. Each class session is 110 minutes in length, for a total of 2750 minutes of in-class time. The course meets from Monday to Friday. ECNU awards 3 credits for this course. Different universities may count course credits differently. Consult officials at your own home institution.

Attendance

Summer school is very intense and to be successful, students need to attend every class. Occasionally, due to illness or other unavoidable circumstance, a student may need to miss a class. ECNU policy requires a medical certificate to be excused. Any absence may impact on the student's grade. Moreover, ECNU policy is that a student who has more than 3 absences will fail the course. Arriving late or leaving early will count as a partial absence.

Grading Policy



ECNU awards grades of A, A-, B+, B, B-, C+, C, D, and F. Most colleges and universities do not award transfer credit for grades of D or F.

In this course, grading will be based on the following:

Quizzes*2	10%*2=20%
Assignment*2	10%*2=20%
Midterm Exam	20%
Final Exam	40%

General Expectations

Students are expected to:

- Attend all classes and be responsible for all material covered in class and otherwise assigned. Any unexcused absence may impact a student's grade.
- Arrive to class on-time: Late arrivals are disruptive to your fellow students and to the conduct of the class.
- Complete the day's required reading and assignments before class.
- Review the previous day's notes before class; make notes about questions you have about the previous class or the day's reading.
- Refrain from texting, phoning or engaging in computer activities unrelated to class during class (不要用手机). It is highly disrespectful to the professor and to the class.
- Participate in class discussions and complete required written work on time.

Course Schedule

The planned schedule sketched out below may be modified to suit the interests or abilities of the enrolled students or to take advantage of special opportunities or events that may arise during the term.

Week 1

- *Day 1*
 - o *Overview of the course*
- *Day 2*



- *Vectors in R^n and C^n , Spatial Vectors: Vector Addition and Scalar Multiplication*
- *Day 3*
 - *Vectors in R^n and C^n , Spatial Vectors: Located Vectors, Hyperplanes, Lanes*
- *Day 4*
 - *Vectors in R^n and C^n , Spatial Vectors: Vectors in R^3 , Complex Numbers*
- *Day 5*
 - *Tutorial/Discussion*
 - *Quiz 1*

Week 2

- *Day 1*
 - *Algebra of Matrices: Summation Symbol, Matrix Multiplication*
- *Day 2*
 - *Algebra of Matrices: Transpose of a Matrix, Square Matrices*
- *Day 3*
 - *Systems of Linear Equations*
- *Day 4*
 - *Systems of Linear Equations*
- *Day 5*
 - *Tutorial/ Discussion*
 - *Assignment 1 due*

Week 3

- *Day 1*
 - *Vector Spaces*



- *Day 2*
 - o *Linear Mappings*
- *Day 3*
 - o *Vector Spaces and Linear Operator: Linear transformations and operators*
- *Day 4*
 - o *Midterm Review Session*
 - o *Discussion/Tutorial*
- *Day 5*
 - o *Midterm*

Week 4

- *Day 1*
 - o *Vector Spaces and Linear Operator: Matrix representations of linear operators*
- *Day 2*
 - o *Orthogonality: Orthogonal vectors and subspaces*
 - o *Orthogonal projections and least squares approximations*
- *Day 3*
 - o *Eigenvalues and Eigenvectors: Diagonalization of matrices*
- *Day 4*
 - o *Eigenvalues and Eigenvectors: Applications in stability analysis, dynamical systems, and data analysis*
- *Day 5*
 - o *Tutorial/Discussion*
 - o *Quiz 2*

Week 5



- *Day 1*
 - o *Diagonalization of Hermitian Matrices*
- *Day 2*
 - o *Diagonalization of Hermitian Matrices: Spectral theorem and diagonalization of Hermitian matrices*
- *Day 3*
 - o *Diagonalization of Hermitian Matrices: Applications in quantum mechanics, signal processing, and optimization*
- *Day 4*
 - o *Final Exam Review Session*
 - o *Tutorial/Discussion*
- *Day 5*
 - o *Final Exam*
 - o *Assignment 2 due*

Academic Honesty

Students are expected to maintain high standards of academic honesty. Specifically, unless otherwise directed by the professor, students may not consult other students, books, notes, electronic devices or any other source, on examinations. Failure to abide by this may result in a zero on the examination, or even failure in the course.