University of International Business and Economics
International Summer School

MAT 210 Linear Algebra

Term: October 10th–December 2nd, 2022
Instructor: Wanchunzi Yu
Home Institution: Bridgewater State University
Email: wanchunziyu@gmail.com
Class Hours: 240–360 minutes each week (2,400 minutes in total)
Office Hours: TBD
Discussion session: 60–120 minutes each week

Total Contact Hours: 64 contact hours (45 minutes each, 48 hours in total)
Location: WEB (Live Streams & Pre-recorded Videos)
Credit: 4 units

Course Description:

In the course, the student will gain a familiarity with the theory of linear algebra and its applications. At the same time, more broadly, the student will be introduced to pure (i.e., theoretical) mathematics. That is: the student will increase his/her ability to absorb effectively abstract theory, to read and write mathematically rigorous argument, to extrapolate from fundamental principles, and to attempt creative answers to unfamiliar problems. The student will develop an intuition for theoretical constructs and familiarity with the mathematical style of rigorous argument with which to substantiate that intuition; as well as practice the patience needed to deal with sophisticated mathematical concepts.

Course Goals:

Students who satisfactorily complete this course will:

1. Be familiar with the statements and meanings of the definitions of the fundamental concepts of linear algebra, e.g., vector space, null space, linear independence, basis, dimension, linear transformation, one-to-one, onto, kernel, eigenvector, eigenvalue, orthogonal complement, diagonalizability, etc.

2. Have facility with basic calculational skills, e.g., Gaussian elimination; calculating the determinant, row space, null space, etc. of a matrix; conversion of coordinate vectors between bases; finding the matrix representation of a linear transformation with respect to given bases; determining the eigenspaces of a matrix; etc.

3. Be able to justify, with mathematical rigor, the fundamental theoretical statements of linear algebra (e.g., the fact that a matrix is invertible if and only if its determinant is nonzero; the Rank Theorem; etc.).

4. Have developed the ability to rigorously write mathematical arguments to justify (possibly previously unseen) claims based on their expanding theoretical knowledge.

Required Textbook:

Linear Algebra: A Modern Introduction (with WebAssign), 4th Edition, By David Poole

Grading Policy:

There will be one midterm and a final exam in this class. All exams will be closed-book. No notes, calculators, or other electronic devices will be allowed. and having such a device in view during the exam is an academic honesty violation.

Grading Scale:

The course grades will be calculated based on the following percentages:

- Homework: 30%
- Quizzes/Attendance: 20%
- Midterm: 25%
- Final Exam: 25%

Assignments and examinations will be graded according to the following grade scale:

A	90-100	**C+**	72-74
A-	85-89	**C**	68-71
B+	82-84	**C-**	64-67
B	78-81	**D**	60-63
B-	75-77	**F**	below 60

Class Rules:

All academic work should be done with the high level of honesty and integrity. Academic misconduct of any kind may result in a grade penalty or the assignment of a failing grade.

Course Schedule:

Week	Lecture
Week 1	**Zoom synchronous meeting 1**: Syllabus + Course Introduction + Chapter 1 Introduction 1.0: Introduction: The Racetrack Game 1.1: The Geometry and Algebra of Vectors 1.2: Length and Angle: The Dot Product 1.3: Lines and Planes 1.4: Applications **Zoom synchronous meeting 2**: Chapter 1 Review + Chapter 2 Introduction) 2.0: Introduction: Triviality

	2.1: Introduction to Systems of Linear Equations 2.2: Direct Methods for Solving Linear Systems
Week 2	2.3: Spanning Sets and Linear Independence 2.4: Applications 2.5: Iterative Methods for Solving Linear Systems **Zoom synchronous meeting 3: Chapter 2 Review + Chapter 3 Introduction** 3.0: Introduction: Matrices in Action 3.1: Matrix Operations
Week 3	3.2: Matrix Algebra 3.3: The Inverse of a Matrix 3.4: The LU Factorization 3.5: Subspaces, Basis, Dimension, and Rank **Zoom synchronous meeting 4: Chapter 3 Review 1**
Week 4	3.6: Introduction to Linear Transformations 3.7: Applications **Zoom synchronous meeting 5: Chapter 3 Review 2 + Chapter 4 Introduction** **Zoom synchronous meeting 6: Exercises Session** 4.0: Introduction: A Dynamical System on Graphs 4.1: Introduction to Eigenvalues and Eigenvectors
Week 5	4.2: Determinants 4.3: Eigenvalues and Eigenvectors of n × n Matrices **Zoom synchronous meeting 7: Chapter 4 Review 1** **Zoom synchronous meeting 8: Midterm Exam Review** Midterm Exam Review & Midterm Exam
Week 6	4.4: Similarity and Diagonalization 4.5: Iterative Methods for Computing Eigenvalues 4.6: Applications and the Perron-Frobenius Theorem **Zoom synchronous meeting 9: Chapter 4 Review 2+Chapter 5 Introduction** 5.0: Introduction: Shadows on a Wall 5.1: Orthogonality in R^n
Week 7	5.2: Orthogonal Complements and Orthogonal Projections 5.3: The Gram-Schmidt Process and the QR Factorization 5.4: Orthogonal Diagonalization of Symmetric Matrices **Zoom synchronous meeting 10: Chapter 5 Review 1 + Chapter 6 Introduction**
Week 8	6.0: Introduction: Fibonacci in (Vector) Space 6.1: Vector Spaces and Subspaces 6.2: Linear Independence, Basis, and Dimension 6.3: Change of Basis 6.4: Linear Transformations **Zoom synchronous meeting 11: Chapter 6 Review** **Zoom synchronous meeting 12: Final Exam Review** Final Exam Review & Final Exam

General Comments:

1. In order to train your minds in mathematical thinking, much of lecture will consist of the "Socratic Method" of questioning. Even if silently, do try to puzzle out the answers. An analogy: the lecture should be a "mental exercise" class. Knowledge cannot be given: it must be stolen.

Engage your mind.

2. Many problems will not be solvable at first (or second) viewing. Be patient: clarify any unknown concepts, try to reduce the problem, brainstorm to unearth possibly relevant concepts, and follow your intuition. It may help to, after a period of hard work, put the problem away. Do not worry if you cannot do every problem: what is important is that you try.

3. If you find yourself getting lost in the material, appoint the office hours with me immediately! It is much is easier to lead a student's mind individually rather than in a group.

4. Note that we may not dot every i or cross every t during class: you are responsible for reading the text. In particular, it is to your advantage to read the material before class; in this way the student becomes an active participant rather than a passive recipient.

5. Tests will check your understanding of the lectures as well as cover homework-type problems; it will benefit you to check after each lecture to see if you've understood the line of the arguments.

Precise knowledge of the theory is vital!