University of International Business and Economics

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International Summer School

MAT 210 Linear Algebra

Term: October 26th – November 20th, 2020
Instructor: Peng Gao
Home Institution: Beihang University
Email: penggao@buaa.edu.cn
Class Hours: Monday through Friday, 120 minutes each day (2,400 minutes in total)
When the course is conducted entirely online, a recording of each lecture which is equivalent to a 120-minutes lecture in classroom will be provided instead, thus the actual length of recording may vary)
Location: WEB
Office Hours: TBD

Total Contact Hours: 64 contact hours (45 minutes each, 48 hours in total)
Location：WEB
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:

Leon, Steven. Linear Algebra with Applications, 8th edition

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.

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

- Homework: 30%
- Midterm: 30%
- Final Exam: 40%

Grading Scale:

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 1
Assignment
Section 1.1: Systems of Linear Equations
Hand in: 8, 9
Supplementary Problems: 6gh, 10, 11
Section 1.2: Row Echelon Form
Hand in: 6, 8
Supplementary Problems: 5dkl, 7, 17

Section 1.3: Matrix Arithmetic
Hand in: 7, 17
Supplementary Problems: 6, 13a, 15
Section 1.4: Matrix Algebra
Hand in: 7, 12
Supplementary Problems: 3, 20, 21, 26, 29
Section 1.5: Elementary Matrices
Hand in: 10c, 15
Supplementary Problems: 8a, 10g, 17, 18, 24, 27
Section 2.1: Matrix Determinant
Hand in: 3d, 6
Supplementary Problems: 1, 3g, 6, 8 (use proof by induction), 10
Section 2.2: Properties of Determinants
Hand in: 6, 12
Supplementary Problems: 3df, 5, 14, *15, 16

Week 2
Assignment
Section 2.3: Matrix Adjoints
Hand in： 1c, 6
Supplementary Problems: 1bd, 10, *12
Section 3.1: Vector Spaces
Hand in: 6, 15
Supplementary Problems: 8, 10
Section 3.2: Subspaces
Hand in: 13, 19
Supplementary Problems: 5, 8, 17, 20
Section 3.3: Linear Independence
Hand in: 6, 16
Supplementary Problems: 2b, 5b, 15, 20
Section 3.4: Basis and Dimension
Hand in: 4, 10
Supplementary Problems: 13, 17
Section 3.5: Change of Basis
Hand in: 6, 10
Supplementary Problems: 2, 3, 4, 7, 9
Midterm Exam

Week 3
Assignment
Section 3.6: Row Space and Column Space
Hand in: 17, 26
Supplementary Problems: 1, 3, 4ef, 8, 10, 14, 19, 24
Section 4.1: Linear Transformations

Hand in: 21, 22
Supplementary Problems: 1, 3, 7, 8, 9ab, 12, 13, 14, 16, 19, 21, 22
Section 4.2: Matrix Representations of Linear Transformations
Hand in: 7, 16
Supplementary Problems: 3, 5, 6, 9, 14, 17, 18b, 20
Section 4.3: Similarity
Hand in: 9, 14
Supplementary Problems: 2, 3, 6, 8, 11, 12, 15a*, 15b
Section 5.1: Scalar Product
Hand in: 1c, 3d
Supplementary Problems: 3ab, 15
Section 5.2: Orthogonal Subspaces
Hand in: 1c, 8
Supplementary Problems: 1b, 6, 7, 14, 15, 17

Week 4

Assignment

Section 5.3: Method of Least Squares
Hand in: 1b, 11
Supplementary Problems: 1c, 2, 9, 14
Section 5.4: Inner Product Spaces
Hand in: 3, 10
Supplementary Problems: 4ab, 7ab, 11
Section 5.4: Inner Product Spaces, Part II
Hand in: 15, 22
Supplementary Problems: *9, 12, 13, 16, 21, *33
Section 5.5: Orthonormal Sets
Hand in: 6, 12
Supplementary Problems: 2, 5, 8, 12, 15, *20, *36
Section 6.1: Eigenvalues and Eigenvectors
Hand in: 1g, 9
Supplementary Problems: 1acf, 2, 3, 6, 12, 21,*32
Section 6.3: Diagonalization
Hand in: 1f, 6
Supplementary Problems: 1ace, 3
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, come to office hours 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 in class: you are responsible for reading the text. In particular, it is to your advantage to read the material before coming to class; in this way the student becomes an active participant rather than a passive recipient.
5. Basic etiquette should be maintained. For example: to give your classmates time to think, please do not blurt out answers unless called upon (or overcome with excitement); please do not walk out of class without prior explanation, etc.
6. Using a cell phone in class is not permitted; students using phones will be penalized 5 percentage points on the next exam.
7. 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!