

Applied Linear Algebra

1. INSTRUCTOR INFORMATION

- Instructor: Tan Cao
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SUNY Korea
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- Phone: 82-32-626-1912
- Email: tan.cao@stonybrook.edu
- Office hours: Monday and Wednesday 2:00 pm – 3:00 pm or by appointment.

2. TEACHING ASSISTANT INFORMATION:

- Soyeon Jeon and Boin Suh
- Email: soyeon.jeon@stonybrook.edu and boin.suh@stonybrook.edu.
- Office address: B517
- Office hours:
 - Soyeon Jeon: Tuesday and Thursday 5:00 pm – 6:00 pm
 - Boin Suh: Monday and Wednesday 4:00 pm – 5:00 pm

3. COURSE DESCRIPTION

3.1. Course Information.

- Course Reference Number (CRN): AMS 210
- Meeting room: C103
- Meeting time: Monday and Wednesday 5:00 pm – 6:20 pm
- Prerequisites: AMS 151 or MAT 131 or MAT 126, or level 7 on the mathematics placement examination.
- Textbook
 - Contemporary Linear Algebra, by Howard Anton, Robert C. Busby, Wiley Publisher. **You need to buy a copy.**
 - Linear Algebra, Cherney, Denton and Waldron, **PDF is available for free.**
- Course Overview: Linear Algebra is a very important and useful course. In this course we study topics including Linear System of Equations, Matrices, Matrix Algebra, Determinant, Vector Spaces, Basis, Linear Transformations, Inner Product & Length, Eigenvalues

3.2. Learning Outcomes. After completing this class, students will be able to:

- (1) Become familiar with a diverse set of linear models and use them to interpret theory and techniques throughout the course:
 - a system of 3 linear equations in 3 unknowns;
 - a Markov chain model;
 - a dynamic (iterative) linear systems of equations;
 - a general equilibrium model.
- (2) Compute and apply basic vector-matrix operations:

- scalar products;
 - matrix-vector products;
 - matrix multiplication.
- (3) Demonstrate diverse uses of scalar and vector measures of a matrix:
 - matrix norms;
 - dominant eigenvalue and dominant eigenvector.
 - (4) Solve a system of linear equations using:
 - Gaussian elimination;
 - determinants;
 - matrix inverses;
 - iterative methods,
 - least squared approximate solutions using pseudo-inverses.
 - (5) Demonstrate how Gaussian elimination determines if a system of linear equations is:
 - overdetermined;
 - underdetermined – and how to determine the family of solutions;
 - uniquely determined – and find the solution.
 - (6) Apply basic ideas of numerical linear algebra:
 - computational complexity of matrix operations;
 - LU decomposition;
 - using partitioning to simplify matrix operations;
 - ill-conditioned matrices and the condition number of a matrix.
 - (7) Learn and use basic theory about the vector spaces associated with a linear transformation:
 - linear independence;
 - the null space;
 - the range space;
 - orthonormal spaces.
 - (8) Examine a sampling of linear models, chosen from linear regression, computer graphics, markov chains, and linear programming.
 - (9) Strengthen ability in communicating and translating of mathematical concepts, models to real world settings:
 - present solutions to problems in a clear, well-laid out fashion;
 - explain key concepts from the class in written English;
 - convert problems described in written English into an appropriate mathematical form;
 - convert the mathematical solutions into a written answer.

3.3. Attendance.

- (1) All students of SUNY Korea are required to attend every class.
- (2) Unexcused absences will affect seriously the student's final grade in the course.
- (3) If a student has over 20% unexcused absence (6 days), the student's final course grade will be an 'F'. Example:
 - (a) If the class is a 150 minute class, and is held once a week, the 4th unexcused absence of a student will lead to an F grade of the course.

- (b) If the class is a 75 minute class, and is held twice a week, the 7th unexcused absence of a student will lead to an F grade of the course.
- (c) If the class is a 50 minute class, and is held three times a week, the 10th unexcused absence of a student will lead to an F grade of the course.
- (d) In Intensive English Course (IEC), if a student misses the class more than 40 hours in a semester, the student will receive an F grade on the course.
- (4) Students should report the reason of absence to the instructor in advance, or immediately after the absence.
- (5) When a student excuses his/her absence, the student must provide documentation of the reason for the absence to the instructor.
- (6) The instructor of the course reserves the right to excuse absences.
- (7) The course instructor may excuse the absence if the submitted documentation fulfills the conditions below.
 - (a) Extreme emergencies (e.g. death in the family)
 - (b) Severe medical reasons with doctor's note (Not a slight illness)
 - (c) Very important events (e.g. national conference, official school event)
- (8) At the end of semester, the course instructor should submit a copy of the attendance sheet to the Academic Affairs Office.

3.4. **Tardiness.** Tardiness disturbs other students, disturbs me, and puts you at a disadvantage for doing well in the class. On the rare occasion that you are tardy, please come in quietly and take a seat in the back.

3.5. **Code of Conduct.** Since every student is entitled to full participation in class without interruption, all students are expected to be in class and prepared to begin on time. All cell phones or other devices that make noise must be turned off and out of sight when you enter the classroom. Disruption of class, whether by talking, noisy devices, eating in class or other inconsiderate behavior, will not be tolerated. Students who violate these rules will be asked to leave the classroom and will not be allowed to return until they have spoken privately with me.

4. HOMEWORK, QUIZZES, TESTS, AND FINAL EXAM

4.1. **Homework.** Homework will be assigned weekly and graded carefully. There will be 10 assignments and two lowest will be dropped. Each homework must be turned in on the due date at the beginning for the class. **Late homework will not be accepted.** You may discuss homework problems with other classmates, or with TAs, or with me. However, you should write the solutions by yourselves. Copying the solutions from other classmates will not be accepted and your HW assignment will be scored 0 if you do so. In order to be accepted you must:

- Download the assignment to your computer and print it out.
- Put your name and your number (found in the sign-in sheet) in the upper right hand corner.
- Staple the assignment together.
- Show all your supporting work. **Please do not just write the final answer.**
- Box the answer.

- Take pride in your work and make sure it is neat and legible.

I will be particularly interested in how you show your work, since developing good work habits is one of the primary goals of this class.

4.2. **Quizzes and Exams.** There will be a quiz or exam every week except the first week. You will be expected to take two midterm exams and the final exam. Only in the event of an unavoidable emergency will a make-up exam be considered. You may drop the two lowest quiz grade. If you are absent for a quiz the missed quiz becomes your dropped grade.

Important Dates:

- Quiz 1: Wednesday 03/07/2018
- Quiz 2: Wednesday 03/14/2018
- Quiz 3: Wednesday 03/21/2018
- Quiz 4: Wednesday 03/28/2018
- **Midterm Exam 1: Wednesday 04/04/2018**
- Quiz 5: Wednesday 04/11/2018
- Quiz 6: Wednesday 04/18/2018
- Quiz 7: Wednesday 04/25/2018
- Quiz 8: Wednesday 05/02/2018
- **Midterm Exam 2: Wednesday 05/09/2018**
- Quiz 9: Wednesday 05/16/2018
- Quiz 10: Wednesday 05/30/2018

4.3. **Calculators.** You are **not allowed** to use a calculator during the quizzes and exams.

4.4. **Grade Weighting.**

- Attendance: 5%
- Homework (best 8 of 10): 15%
- Midterm Exam: 30%.
- Quizzes (best 8 of 10): 20%.
- Final: 30%.

4.5. **Grade Weighting.**

- Attendance: 5%
- Homework (best 8 of 10): 15%
- Midterm Exam: 30%.
- Quizzes (best 8 of 10): 20%.
- Final: 30%.

4.6. **Grade Scale (as intervals of percentages).**

Percentage	Latin Grade
[93,100]	A
[90,93)	A-
[87,90)	B+
[83,87)	B
[80,83)	B-
[77,80)	C+
[73,77)	C
[70,73)	C-
[67,70)	D+
[63,67)	D
[60,63)	D-
[0,60)	F

4.7. **Final Exam.** Final Exam will be given on **Thursday 06/21/2018** from 9:00 – 11:30 am. The exam room will be announced during the semester.

4.8. **Textbook Coverage.** In the primary textbook we will cover most of the following sections (with some omissions and additions) from chapter 1 to chapter 9:

- (1) Vectors: the concept of vectors and matrices, dot product & orthogonality, vector equations of lines and planes (chapter 1.)
- (2) Solving systems of linear equations (chapter 2.)
- (3) Matrices: matrix algebra, matrix operations, determinants, eigenvalues and eigenvectors (chapter 3 and 4.)
- (4) Matrix models: dynamical systems and Markov Chains (chapter 5.)
- (5) Linear transformations (chapter 6.)
- (6) Dimension and structure (chapter 7.)
- (7) Diagonalization (chapter 8.)
- (8) General vector spaces (chapter 9.)

5. TENTATIVE COURSE SCHEDULE

Week	Date	Section	Material Covered
1	02/26	1.1	Vectors and Matrices in Engineering and Mathematics; n -Space
	02/28	1.1	Vectors and Matrices in Engineering and Mathematics; n -Space
		1.2	Dot Product and Orthogonality
2	03/05	1.2	Dot Product and Orthogonality
	03/07	2.1	Introduction to Systems of Linear Equations
3	03/12	2.2	Solving Linear Systems by Row Reduction
	03/14	2.2	Solving Linear Systems by Row Reduction
4	03/21	3.1	Operations on Matrices
		3.1	Operations on Matrices
	03/26	3.2	Inverses; Algebraic Properties of Matrices
5	03/28	3.2	Inverses; Algebraic Properties of Matrices
	04/02		Review
6	04/04		Exam 1
	04/09	3.3	Elementary Matrices; A method for Finding A^{-1}
7	04/11	3.3	Elementary Matrices; A method for Finding A^{-1}
		3.4	Subspaces and Linear Independence
	04/16	3.4	Subspaces and Linear Independence
		3.5	The Geometry of Linear Systems
8	04/18	3.5	The Geometry of Linear Systems
	04/23	3.6	Matrices with Special Forms
9	04/25	3.7	Matrix Factorizations; LU -Decomposition
	04/30	3.8	Partitioned Matrices and Parallel Processing
10	05/02	4.1	Determinants; Cofactor Expansion
	05/07		Review
11	05/09		Exam 2
	05/14	4.2	Properties of Determinants
12	05/16	4.3	Cramer's Rule: Formula for A^{-1} , Applications of Determinant
	05/23	4.3	Cramer's Rule: Formula for A^{-1} , Applications of Determinant
		4.4	A first Look at Eigenvalues and Eigenvectors
13	05/28	4.4	A first Look at Eigenvalues and Eigenvectors
		6.1	Matrices as Transformations
	05/30	6.1	Matrices as Transformations
		7.1	Basis and Dimension
14	06/04	7.1	Basis and Dimension
		8.1	Matrix Representations of Linear Transformations
		9.1	Vector Space Axioms
	06/11		Review

6. OTHER RESOURCES AND MISCELLANEOUS

6.1. **Tips for Success.** Commit yourself to the class on day one. If you devote ample time to working on homework, reading the textbook and your notes, and thinking about

the concepts we are learning, you will learn this material and you will learn it well. You will build a strong foundation for future math and science classes, as well as good study and organizational habits, which will be essential throughout your university studies. You have the ability to reach success if you commit yourself to excellence. Moreover, you do not have to reach success alone. Get to know your classmates, and learn with and from each other. Come to see me whenever you have questions.

6.2. Religious Holidays. (from the online Academic Calendar): Because of the extraordinary variety of religious affiliations of the University student body and staff, the Academic Calendar makes no provisions for religious holidays. However, it is University policy to respect the faith and religious obligations of the individual. Students with classes or examinations that conflict with their religious observances are expected to notify their instructors well in advance so that mutually agreeable alternatives may be worked out.

6.3. Academic Dishonesty. Plagiarism and Cheating: Academic misbehavior means any activity that tends to compromise the academic integrity of the institution or subvert the education process. All forms of academic misbehavior are prohibited at SUNY Korea. Students who commit or assist in committing dishonest acts are subject to downgrading (to a failing grade for the test, paper, or other course-related activity in question, or for the entire course) and/or additional sanctions.

Cheating: Intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information or assistance in any academic exercise. Examples include: (a) copying from another student's test paper; (b) allowing another student to copy from a test paper; (c) using unauthorized material such as a "cheat sheet" during an exam.

Fabrication: Intentional and unauthorized falsification of any information or citation. Examples include: (a) citation of information not taken from the source indicated; (b) listing sources in a bibliography not used in a research paper.

Plagiarism: To take and use another's words or ideas as one's own. Examples include: (a) failure to use appropriate referencing when using the words or ideas of other persons; (b) altering the language, paraphrasing, omitting, rearranging, or forming new combinations of words in an attempt to make the thoughts of another appear as your own.

Other forms of academic misbehavior include, but are not limited to: (a) unauthorized use of resources, or any attempt to limit another student's access to educational resources, or any attempt to alter equipment so as to lead to an incorrect answer for subsequent users; (b) enlisting the assistance of a substitute in the taking of examinations; (c) violating course rules as defined in the course syllabus or other written information provided to the student; (d) selling, buying or stealing all or part of an un-administered test or answers to the test; (e) changing or altering a grade on a test or other academic grade records.

6.4. Disability Support Services (DSS) Statement. If you have a physical, psychological, medical or learning disability that may impact your course work, please contact One-Stop Service Center, Academic Building A201, (82) 32-626-1117. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

In addition, this statement on emergency evacuation is often included, but not required: Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and One-Stop Service Center.

6.5. Course Evaluations. Stony Brook University values student feedback in maintaining the high quality education it provides and is committed to the course evaluation process, which includes a mid-semester assessment as well as an end-of-the-semester assessment, giving students a chance to provide information and feedback to an instructor which allows for development and improvement of courses. Please click the the following link to access the course evaluation system: <http://stonybrook.campuslabs.com/courseeval/>

DEPARTMENT OF APPLIED MATHEMATICS AND STATISTICS

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