

MAT 211, Spring 2015, [Introduction to Linear Algebra](#).

Lecture 04, 53103: MWF 10-10:53 AM.

Location: Library W4535

Contact: mtehrani@scgp.stonybrook.edu

Final Exam: Monday 5/18/15 8:00 AM-10:45 AM

The aim of this course is to introduce you to the basic ideas of Linear Algebra without going into the technical details. We will learn how to solve some simple but useful problems, and the course will be mostly about computation.

Textbook: [Linear Algebra with Applications](#) by Otto Bretscher, Fifth Edition, Pearson, 2012.

Office Hours: My office is located in Simons Center 508 (Glass building next to Mathematics Department). My office hours are MW 3-4 PM in my office or Monday 11-12 in MLC. Alternatively, you can email me and I can meet you some other time. You can also visit the Math Learning Center for additional support, open weekdays 10-6pm.

Homepage: <http://mysbfiles.stonybrook.edu/~mfarajzadeht/teaching.html>

Grading: There will be two midterm exams, each counting for 20% of your grade, and one final exam worth 40%. The remaining 20% of your grade will be from homeworks, which will be set on **Monday** and collected next week **Monday**.

At least the lowest two homework grades will be dropped. That means you can get away with doing no homework at all on two separate weeks before it starts to affect your grade. Hopefully this will cover any missed buses, dying pets, terrible hangovers, and other small problems. If you are worried that you might be falling behind, or if something comes up that might affect your grade, then please come and see me - we can certainly work something out.

If you haven't spoken to me personally, however, then there will be **no late homeworks accepted**. And telling me about your problems *after* the final is no good: once I've submitted the grades to the department, they cannot be changed. So please talk to me in advance.

Read the textbook: It's very important to read (and really understand) the text book both before and after the lecture since we don't have time to cover all the details from the book.

Caution: Following information will be constantly updated

Week by week syllabus and progress of the class:

Week 1+, 01/30-02/06: Sections 1.1, 1.2

HW1 (12 Questions), Due Friday Feb 13 :

(1.1): 2, 8, 12, 18, 32, 36. (1.2): 2, 10, 16, 24, 32, 36.

Topics: Introduction to basic concepts: What does linear algebra mean? Linear systems, Matrices, Vectors, Geometric interpretations, Uniqueness of solutions, Vector spaces, Gauss-Jordan elimination.

Week 2, 02/09-02/13: Sections 1.2, 1.3, 2.1

HW2 (10 Questions), Due Friday Feb 20:

(1.3): 1.a, 4, 7, 10, 11, 24, 35.

(2.1): 5, 8 (i.e. write x variables in term of y variables), 33.

Topics: reduced row echelon form, rank of matrices, number equations vs. number of variables, case of $n \times n$ matrices, linear combinations, another geometric meaning of linear equations, dot product, relation with the columns of the matrix, geometric meaning of dot product, span of vectors.

Week 3, 02/16-02/20: Chapter 2 and some touches from Chapter 3

HW3 (11 Questions), Due Friday Feb 25:

(2.1) 36, 44

(2.2) 1, 6, 21, 37

(2.3) 7, 15, 29, 38, 46.

Topics: Linear transformations, some important class of linear maps, abstract linear maps, more on matrix multiplication.

Week 4, 02/23-02/27: Section 2.3 and Section 3.1

HW4, to be returned during Midterm 1:

This HW has to be **typed, printed, and returned on the day of Midterm 1.**

What to do: In the first paragraph, and in few lines, you introduce your field of study, a subject in which you plan to study in future, or just any subject in which you are interested.

Then in 1(at least) to 5(at most) pages, I want you to describe a problem/topic/calculation in your field of study (that you have described in the first paragraph) which uses the concepts of linear algebra such as linear maps, matrix calculations, vector spaces, Eigen vectors, You need to properly introduce the problem/subject and clearly recall those linear algebra concepts that are used to formulate or solve the problem. You don't need to bring in proofs and details, just a proper and precise introduction and formulation.

For example, theory of Markov chains in probability and statistics uses matrix calculations to formulate and find steady state of probabilistic systems. This example is discussed in some details in pages 83-84.

Feel free to consult any book, internet, or senior people of your major. I only expect you to write it yourself. Learn from any resource you like, but write it in your own words. Start from now and don't leave it for the last moment. **If you don't like to do so, you don't have to; as I said at the beginning, lowest two homeworks will be dropped.**

Topics: Inverse of linear maps, kernel and image, basis, more on matrix multiplication.

Week 5, 03/02-03/06: Sections 3.2, 3.3

Midterm 1, Wednesday March 4 8:00-9:30 PM

Location: TBD

HW5, Due next Monday in class:

(2.4) 8, 20, 28, 32,

(3.1) 12, 21, 37, 46

(3.2) 1, 6, 8, 46

Look at the following questions for yourself: (2.4) 67-75, 76, 80, 82-84.

Topics: More on subspaces, linearly independent vectors, redundant vectors, base (smallest number of vectors needed to span), base for the image. non-trivial relations vs. kernel, various characterizations, unique representation in terms of basis (coordinates), dimension of subspaces, finding a base for kernel and image, rank-nullity theorem.

Week 6, 03/09-03/13: Sections 3.4

HW6, Due Monday 03/23 in class:

(3.3) 6,10,22,28,32,36,38

(3.4) 2,6,20,28,38

Topics: Coordinates, Matrix of linear maps in a basis, Relation to the standard presentation, Theorem 3.4.4, similar (conjugate) matrices, Theorem 3.4.6, matrices similar to diagonal.

********* Try to read Chapter 4 by yourself during the break. We have already discussed some of the materials of this chapter in the past lectures. So, we would cover it fast after the break. That's why I want you to read through this chapter before then *********

Week 03/16-03/20:

Spring Recess, NO CLASS, but work on Chapter 3, it is very important.

Week 7, 03/23-03/27: Chapter 4

HW7, Due next Monday in class:

(4.1) 8, 10, 14, 26, 30, 40

(4.2) 4, 8, 12, 22, 28, 48

Topics: Linear spaces, Examples: solution of homogenous ODEs, space of functions and matrices, infinite dimensional examples, subspaces, span, linear independence, basis, coordinates, solution set of linear differential equations.

Linear transformations, image, kernel, rank, nullity, isomorphisms, matrix of linear transformations, change of basis.

Week 8, 03/30-04/03: Section 4.3, 5.1,5.2

HW8, Due next Monday in class:

(4.3) 8, 12, 22, 28, 32

(5.1) 8, 12, 16, 22, 26

Topics: matrix of linear transformations, change of basis. Length of vectors, unit vectors, orthonormal frame, projection maps, orthogonal complement, Pythagorean Theorem, Cauchy-Schwarz inequality, Angle between vectors, Gram-Schmidt Process, QR factorization.

Week 9, 04/06-04/10: Section 5.3, 5.5

Midterm 2 Monday April 06, Includes Chapters 1-4 with emphasis on Chapters 3,4.

HW9, Due next Monday in class:

(5.2) 8, 12, 16, 28, 44

(5.3) 10, 20, 24, 32, 42, 48

Topics: Orthogonal transformation, transpose of a matrix, symmetric and skew-symmetric matrices, inverse of orthogonal matrices. Inner products, orthonormal basis, orthogonal projection, and orthogonal maps between abstract vector spaces. Fourier Series.

Read Section 5.4 by yourself, if you like; it wont be in final.

Week 10, 04/13-04/17: Chapter 6

HW10, Due next Monday in class:

(5.5) 2, 8, 10, 18, 22

(6.1) 8, 10, 16, 22, 42

Topics: Determinant, volume of parallelogram and parallelepiped. Sarrus's rule. Linearity properties of determinant.

Week 11, 04/20-04/24: Chapters 6, Section 7.1

HW11, Due next Monday in class:

(6.2) 6, 10, 20, 25, 28

(6.3) 2, 14, 24, 25, 26

Topics: Elementary row operations and determinant. Minors. Determinant of abstract linear transformations. Cramer's rule. Diagonal matrices, diagonalizable matrices, eigenvectors and eigenvalues, eigenbases.

Read Sections 7.4, 7.6 and Dynamical system part of Sec 7.1 by yourself, if you like; it won't be in exam.

Week 12, 04/27-05/01: Chapter 7

HW12, Due next Monday in class:

(7.1) 8, 18, 34, 64

(7.2) 10, 13, 15, 17, 22, 33

Topics: Finding eigenvalues and eigenvectors. Characteristic polynomial. Algebraic multiplicity of eigenvalues. Eigenvalues and its relation to determinant and trace. Complex eigenvalues.

Week 13, 05/04-05/08: Chapter 8, Quadratic forms

HW13, Due Wednesday May 13 (Drop at my office)

(7.3) 8, 21, 25, 26

(7.5) 1, 3, 11, 14

(8.1) 6, 9, 42

(8.2) 3, 6, 10, 20

Topics: Quadratic forms, orthonormal eigen bases, definiteness, geometric interpretation

Read Sec 8.3 by yourself, if you are interested.

FINISH (I hope you enjoyed it!)

***** Now that you have learned all this stuff, put some time and effort to read and learn Chapter 9. It is about ODE (Ordinary Differential Equation); you will see it a lot in future, even if you are biology major.

***** I try to set up a review class on Wednesday May 13. I will notify you after I confirm the location and time with people at math department.

