M346 (56615)
Applied Linear Algebra, Spring 2013
Course syllabus (last revised: 03/29/2013)

Instructor: Ravi Srinivasan
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Office: RLM 11.164
Office hours: M 3:30-5:30 (tentative, will change depending on HW due dates)

Lecture: TTh 3:30-5, WEL 2.308
Class website: http://www.ma.utexas.edu/users/rav/M346/

Required texts:
(1) ``Applied Linear Algebra: The Decoupling Principle (2nd ed.)'' by L. Sadun (ISBN 0821844415);
(2) ``Linear Algebra Done Wrong'' by S. Treil (http://www.math.brown.edu/~treil/papers/LADW/book.pdf)

Prerequisites and degree relevance:
A grade of C or better in M341 (or M311) or M340L, or consent of the instructor.

Course description and content:
This is an advanced undergraduate course on linear algebra directed at students in the natural and social sciences and at engineering students. The emphasis in this course is both on theoretical considerations (with rigorous proofs of results) and on problem solving. Topics include vector spaces, linear transformations and matrix representation, spectral theory (both discrete and continuous), diagonalization of linear operators, inner products and duality, Hermitian (i.e., self-adjoint) and unitary operators, the Fourier transform, and applications to differential equations, probability theory, network analysis, and statistics.

This course carries the 'Quantitative Reasoning' flag. Quantitative reasoning courses are designed to equip you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your professional life. You should therefore expect a substantial portion of your grade to come from your use of quantitative skills to analyze real-world problems.

Notice:
The University of Texas provides appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-6441 TTY. If you plan on using accommodations, you need to notify your instructors early in the semester.

Important dates:

Thu., Jan. 17, 2013 -- Last day of official add/drop period
Wed., Jan. 30, 2013 -- Last day to drop a course for possible refund (can only Q-drop after this date)
Mon., Apr. 01, 2013 -- Last day to withdraw/drop a class with Dean's approval, change status to or from a pass/fail basis

Grading:
Grades will be determined from weekly homework/quizzes, midterms, and the final exam (see below). Course grades will be computed on a +/- basis according to a scheme at least as generous as this (rounded to the closest integer):

A : 92-100
A-: 90-91
B+: 88-89
B : 82-87
B-: 80-81
C+: 78-79
C : 72-77
C-: 70-71
D+: 68-69
D : 62-67
D-: 60-61
F : < 60

1. Homework: 20%
Homework assignments will be posted online every week on the class website, approximately one week before it is due. Assignments will be due almost every Wednesday in lecture, and late homework will *not* be accepted. The purpose of the HW is to learn the material. You are encouraged to discuss and work together on these problems, including during office hours. Learn to correctly and consistently derive the answer (without a calculator) in order to better prepare for exams. Do not restrict yourself to HW problems, but use them as a basis for trying questions from the book as well. Only a select set of questions will be graded each week, and you will get a minimal amount of credit simply for handing in your complete HW solutions.

The *three* lowest HW grades will be dropped to allow for missed lectures, illness, emergencies, etc. Even if you do not hand in HW solutions, make sure to complete the assigned problems in order to prepare for exams.

2. Midterm exams: 45%
There will be two 75-minute midterms given in regular class times on the following dates (subject to change):

2a. Midterm #1: 20%
Tuesday, Feb. 19, 2013

2b. Midterm #2 (not comprehensive): 25%
Thursday, Apr. 04, 2013

3. Final exam (comprehensive): 35%
Saturday, May 11, 9am-12pm (officially assigned date/time), location TBA

Exam policy:
A valid photo ID must be available to be checked at all exams. Calculators, books, and notes are not permitted during quizzes, midterms, and the final exam.

Make-up exams **will not** be given so please remember the appropriate exam dates. In extraordinary circumstances ONLY, the final exam score will compensate for a missing midterm exam. This includes illness, observance of a religious holiday, or a university-related absence *with two weeks advance notice.* Proper documentation (such as a doctor's note) is required in all cases.

Some tips:
- Ask questions: In lecture, office hours, and by e-mail. Don't be shy--if you have a question it's likely someone else does as well. Class participation makes lectures more interesting and fun for both you and me.
- Do the homework: No one can learn mathematics without working examples themselves. The most important driver of success in virtually every math course is doing practice exercises carefully and completely.
- Read the text: To get the most benefit from the lectures and problem sessions, you should read relevant sections of the text as they are covered in class. The supplementary texts listed can also be useful references at particular times in the course.
- Come to office hours: Office hours offer valuable opportunities to reinforce concepts, clarify confusing issues, work more examples, and get individualized feedback.
- Study together: You are encouraged to study together with your peers enrolled in the class. Get to know your classmates, and make arrangements to share notes in case you miss class due to illness.
- Learn to work problems without a calculator: You may use a calculator on homework problems but not during quizzes or exams. In any case, a calculator will not be useful for the vast majority of problems encountered during the semester.
- Be honest: Any academic dishonesty will be severely penalized.

Tentative course calendar (subject to change):

======== PART I: Basis, finite-dimensional linear operators, and eigenvalues ========

--Week 01--
Topics: Introduction (1.1), vector spaces (2.1), matrix operations (Appendix A), basis and dimension (2.2)

Tu 01/15   First lecture
Th 01/17

--Week 02--
Topics: Properties and change of basis (2.3-2.4), linear transformations and matrix representation (3.1-3.2)
Tu 01/22   HW1 due
Th 01/24

--Week 03--
Topics: Basis and operators (3.3), subspaces (3.5), eigenvalues and eigenvectors (4.1-4.2)
Tu 01/29   HW2 due
Th 01/31

--Week 04--
Topics: Characteristic polynomials (4.3)
Tu 02/05   HW3 due
Th 02/07

======== PART II: Diagonalizability and applications, inner-product spaces ========

--Week 05--
Topics: Complex eigenvalues (4.4), diagonalizability (4.5)
Tu 02/12   HW4 due
Th 02/14

--Week 06--
Topics: Jordan canonical form (4.9)
Tu 02/19   **MIDTERM #1** (on Part I)
Th 02/21

--Week 07--
Topics: Trace and determinant (4.6), first-order difference equations (5.1), matrix exponentials (4.7), systems of first-order ODE (5.2)
Tu 02/26   HW5 due
Th 02/28

--Week 08--
Topics: Stability and asymptotic behavior (5.5), Markov chains (5.6)
Tu 03/05
Th 03/07   HW6 due

--Spring break--

--Week 09--
Topics: Markov chains (cont'd), applications in network science
Tu 03/19
Th 03/21   HW7 due

======== PART III: Self-adjoint operators, spectral theory, and Fourier analysis ========

--Week 10--
Topics: Inner-product spaces (6.1-6.2)
Tu 03/26
Th 03/28   HW8 due

--Week 11--
Topics: Orthogonalization and Gram-Schmidt procedure (6.4-6.5), projections (6.6)
Tu 04/02
Th 04/04   **MIDTERM #2** (on Part II)

--Week 12--
Topics: Least-squares (6.7), adjoints (7.1), Self-adjoint operators (7.2), normal operators
Tu 04/09   HW9 due
Th 04/11

--Week 13--
Topics: Unitary and orthogonal operators (7.4), positive operators, singular value decomposition, applications of SVD
Tu 04/16   HW10 due
Th 04/18

--Week 14--
Topics: Infinite-dimensional spaces (3.4, 6.8), Fourier series (6.9, 8.5, 8.7)
Tu 04/23   HW11 due
Th 04/25

--Week 15--
Topics: Continuous spectrum and generalized eigenfunctions (9.1), Fourier transform (10.1)
Tu 04/30   HW12 due
Th 05/02   Last lecture

--Finals week--
Tu 05/07   HW13 due
Sa 05/11   **FINAL EXAM** 9am-12pm, location TBA