California Institute of Technology
Department of Computing + Mathematical Sciences

ACM 270-2 Applied Linear Algebra

Spring 2016

Lectures:	MW 10:30-11:55 in 107 ANB
Instructor:	Konstantin (Kostia) Zuev
Office:	114 ANB
Email:	kostia@caltech.edu (please include "270-2" in the subject line)
Website:	http://www.its.caltech.edu/~zuev/
Office Hours:	MW 15:00-16:00, or by appointment (please, send an email to schedule)
Teaching Assistant:	TBA (email: TBA, office: TBA, hours: TBA)

Course Description

This is an intermediate linear algebra course aimed at a diverse group of students, including junior and senior majors in applied mathematics, and graduate students in sciences and engineering. The focus is on applications. Matrix factorizations play a central role. Topics covered include linear systems, vector spaces and bases, inner products, norms, minimization, least squares approximation, data fitting, interpolation, orthogonality, the QR factorization, ill-conditioned systems, eigenvalues and eigenvectors, the spectral theorem, optimization principles for eigenvalues, singular value decomposition, condition number, principle component analysis, the Schur decomposition, methods for computing eigenvalues, non-negative matrices, graphs, networks, random walks, the Perron-Frobenius theorem, PageRank algorithm. The key part of the course is homework, where students will obtain experience in undertaking linear algebra computations in MATLAB.

Prerequisites

- Ma 1 abc (analytic track), Ma 2, and ACM 95 ab; or instructor's permission.
- Some familiarity with MATLAB, e.g. ACM 11, is desired.

Textbooks

- P.J. Olver & C. Shakiban, *Applied Linear Algebra* (main)
- L. Sadun, *Applied Linear Algebra* (supplementary)
- P.D. Lax, *Linear Algebra and its Applications* (supplementary)

Course Plan

The following is a tentative outline of the topics to be covered this term.

Week 1	Linear Systems, MATLAB crash course
Week 2	Vector Spaces and Bases
Week 3	Inner Products, Norms, and Minimization
Week 4	Orthogonality, the Gram-Schmidt process, the QR factorization
Week 5	Application to the analysis of equilibrium configurations
Week 6-7	Eigenvalues, Singular Value Decomposition, Principle Component Analysis
Week 7-8	Applications: Discrete-Time Evolution, Difference Equations, Markov Chains
Week 9	Iterations of Linear Systems, Stability, Methods for Computing Eigenvalues
Week 10	Nonnegative Matrices, Graphs, Networks, Random Walks, PageRank

Grading

Your final grade will be based on your total score. Your total score is a weighted average of Homework (50%), the Midterm exam (25%), and the Final exam (25%). There are no fixed thresholds for grades, but if your total score is 90% (80%, 70%, 60%), you are guaranteed at least "A" ("B", "C", "D").

Homework

There will be six homework assignments. Homework problems and due dates will be posted on the course website (for exact dates see "Important Dates" below). Late homework will not be accepted for any reason, but the homework with the lowest score will be dropped and not counted toward your total score. Extensions may be granted for academic (with at least one week notice) or medical reasons.

Exams

There will be two exams: midterm and final. The exams are closed-book, but you can use your own notes. No electronic devices are permitted (e.g. no computers, tablets, phones, etc).

Quizzes

There will be a random number of ~10 min quizzes given on random days. Please, consider quizzes not as a punishment (they will not affect your total score and final grade in any way!), but as an incentive to learn the material and prepare to the exams in advance. Think of a random quiz as a morning espresso shot.

Collaboration Policy

If you get stuck with a homework problem, I encourage you to discuss it with other students. Nevertheless, you will have to prepare and submit your homework by yourself. No collaboration is allowed on the midterm and final exams.

Important Dates

Quizzes:	TBA
Homework:	TBA
Midterm:	TBA
Final:	TBA

Websites

Homework assuagements, due dates, and other course related information and materials will be posted on the course website. You are expected to check it regularly.
http://www.its.caltech.edu/~zuev/teaching/2016Winter/ACM270-2.html
Class discussion will be managed via Piazza, which is designed such that you can get a quick help from your classmates, the TA(s), and the instructor. Instead of emailing questions to the teaching staff, I encourage you to post your questions on Piazza because a) you will get the answers faster b) your classmates may also benefit from seeing the answers to your questions. Enroll here:
https://piazza.com/caltech/spring2016/acm2702/home

Honor Code

You must conform to the honor code:
"No member of the Caltech community shall take unfair advantage of any other member of the Caltech community."
In-Class Behavior
Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Undergraduate Board of Control or the Graduate Honor Council. In particular, the use of cell phones during class or conversation is disruptive behavior.
Academic Integrity
All students are responsible for maintaining standards of academic integrity. In particular, collaboration during midterms or the final are strictly prohibited.

This syllabus is not a contract, and the Instructor reserves the right to make some changes during the term.