

SYLLABUS

TITLE: NUMERICAL ANALYSIS: LINEAR ALGEBRA
NUMBER: CSE 383/CS 383/M 383/SSC 383/ME 397
WHERE: GDC 4.302
WHEN: T,TH 9:30am--11am 8/25--12/1
INSTRUCTOR: George Biros, Email me using CANVAS (or gbiros@acm.org)
OFFICE: POB 5.234
OFFICE HOURS: T, TH, 11:15am-12:15pm
TEACHING ASSISTANT: Siddhant Wahal (siddhant.wahal@gmail.com)
ONLINE: canvas.utexas.edu
MIDTERM EXAM: Thursday, October 20, 9-12
FINAL EXAM: Thursday, December 8, 2: 00-5:00 pm

OVERVIEW

Numerical linear algebra is a fundamental technology in scientific computing and computer science. From image processing, computer vision, machine learning, and signal analysis, to fluid mechanics, molecular dynamics and computational physics, linear algebra is at the core of all higher-level algorithms. Understanding key numerical linear algebra methods along with some appreciation for their complexity and limitations is invaluable skill for all science and engineering students.

SCHEDULE

[] Fundamentals

- . Vectors, matrices, norms
- . Finite precision arithmetic, numerical stability, condition numbers
- . Backward and forward error analysis
- . Complexity

[] Direct methods for dense matrices

- . Least squares:
 - Singular Value Decomposition
 - QR factorization
 - Gram-Schmidt Orthogonalization
- . Linear systems: LU and Cholesky factorizations
- . Eigenvalue decomposition for Symmetric Positive Definite systems.
 - Rayleigh quotient
 - Schur decomposition

Hessemberg and Triadiagonal forms

- [] Direct and iterative methods for sparse matrices
- . Iterative methods: Conjugate Gradients
- . Randomized Methods: QR and SVD decomposition, skeletonization
- . Sparse and incomplete factorizations: Cholesky, LU

PREREQUISITES

Graduate standing or consent of instructor. Students should have a good knowledge of undergraduate linear algebra. Also, some background in MATLAB is required since there will be several assignments that use the methods we discuss in the class.

GRADING

- Homework assignments (40%) (typically one Hwk/2 weeks)
- Midterm (30%)
- Final Exam (30%)

TEXTBOOK

Numerical Linear Algebra by L. N. Trefethen and D. Bau, SIAM, 1997
ISBN: 978-0-898713-61-9

OTHER BOOKS

- Robert van de Geijn, <http://www.ulaff.net/downloads.html>
- Matrix Computations by G. Golub and C. Van Loan, 3rd Ed. Johns Hopkins Press, 1996.
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The books below are available online at <http://epubs.siam.org>

- Applied Numerical Linear Algebra by James W. Demmel, SIAM, 1997.
- Fundamentals of Matrix Computations by David Watkins, 3rd Ed., 2010.
- Matlab Guide by D. Higham and N. Higham, SIAM, 2005

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