CS 421 NUMERICAL ANALYSIS Fall 1999

MWF 1:25-2:15, Hollister 320

The purpose of this course is to study some of the basic principles of numerical analysis, especially as applied to the solution of systems of equations, both linear and nonlinear. The emphasis will be on the understanding of the fundamental algorithmic ideas underlying modern practical methods.

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Text: Scientific Computing, Michael T. Heath, McGraw-Hill (1997).

Additional books on reserve in the engineering library:

- Coleman & Van Loan, Handbook for Matrix Computations
- Dennis & Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations
- George & Liu, Computer Solution of Large Sparse Positive Definite Systems
- Golub & Van Loan, Matrix Computations
- Kahaner & Moler, Numerical Methods and Software
- Strang, Introduction to Applied Mathematics

Prerequisites: Math 294 (or equivalent), additional math course above 300-level, some programming

Coursework: There will be $5-6$ problem sets (60%), 1 in–class quiz (10%), and a final exam (30%). MATLAB will be used.

Topics [1]

1. Introduction, overview, example sources of equation systems [2 lecs].
2. Direct methods for linear equations [10 lecs, text $1-2$]
   - matrix multiply, triangular systems
   - positive definite systems, Cholesky factorization
   - LU factorization (Gaussian elimination)
   - conditioning/errors/accuracy
   - banded systems/sparse systems
3. Nonlinear equations and minimization [16 lecs, text $3, 5, 6$]
   - local methods for nonlinear systems $F(x) = 0$
   - multi-dimensional minimization
   - linear and nonlinear least squares, QR factorization, global methods for $F(x) = 0$
   - Jacobian estimation: finite-difference vs automatic differentiation
4. Eigenvalue problems[6 lecs, text 4]
   - basics
   - symmetric eigenvalue problem, Jacobi method, QR method, SVD
5. Iterative methods for large linear systems [3 lecs, text 2.6]
6. Additional topics [3 lecs]

[1] Listed in the square brackets '[ ]' beside each topic are the approximate number of lectures devoted to the topic and the relevant chapters of the text.