Math 6800 Computational Linear Algebra Fall 2011

Instructor: D.W. Schwendeman (schwed@rpi.edu, Amos Eaton 422, 276-2647)

Office Hours: Wednesdays 1:30–3:00pm, Fridays 9:30–11:00am, or by appointment.

Web site: `http://eaton.math.rpi.edu/Faculty/Schwendeman/home.html`

Textbooks:

1. Trefethen and Bau, *Numerical Linear Algebra*, SIAM, Philadelphia, 1997 (Required).
2. Golub and Van Loan, *Matrix Computations, 3rd ed.*, Johns Hopkins University Press, Baltimore, 1996 (Reference).

Outline:

1. Introduction

   Matrix-vector multiplication, orthogonal vectors and matrices, norms, the singular-value decomposition (SVD).

2. QR Factorization and Least Squares

   Projectors, QR factorization, Gram-Schmidt orthogonalization, Householder triangularization, least squares problems.

3. Conditioning and Stability

   Conditioning, floating-point arithmetic, stability, stability of Householder triangularization and back substitution, conditioning and stability of least squares.

4. Systems of Equations

   Gaussian elimination, pivoting and stability, Cholesky factorization.

5. Eigenvalue Problems

   Eigenvalue problems and an overview of algorithms, reduction to Hessenberg or tridiagonal form, Rayleigh quotient and inverse iteration, QR algorithm, shifts, other eigenvalue algorithms, computing the SVD.

6. Iterative Methods

   Overview, the Arnoldi iteration, GMRES, the Lanczos iteration, conjugate gradient, preconditioning.

7. Applications and Special Topics (time permitting)

Grading Policy:

- Course grades will be based on exams (midterm and final) and problem sets (pencil & paper and computing problems).
- The weights for these items are 70% for exams (30% midterm and 40% final) and 30% for homework.