MATH 552 - Applications of Scientific Computing
(Topic: Numerical Linear Algebra)
Spring 2006, TTH 9:30-10:45

Instructor: Hans Johnston, 1324 LGRT, 545-2817, johnston@math.umass.edu

Office Hours: TBA

Course Webpage: `www.math.umass.edu/~johnston/M552s06.html`

Text: *Numerical Linear Algebra*, by Trefethen & Bau (SIAM, `www.siam.org`)

Prerequisites: Linear algebra, preferably numerical analysis, and knowledge of a scientific programming language.

Description: This course is an introduction to numerical linear algebra, a core subject in scientific computing. Three types of problems are considered: (1) solving a system of linear equations ($Ax = b$), (2) computing eigenvalues and eigenvectors of a matrix ($Ax = \lambda x$), and (3) least squares problems ($\min \|Ax - b\|_2$). These problems often arise in applications in science and engineering, and many algorithms have been developed for their solution.

Topics: Mostly, the topics will follow the textbook: (1) Fundamentals (from matrix-vector multiplication to the SVD); (2) QR factorization and stability (from QR factorization to linear least squares); (3) Systems of equations (from Gaussian elimination to Cholesky); (4) Eigenvalues (the QR algorithm); and (5) Iterative methods (Lanczos iteration, conjugate gradients, GMRES, Arnoldi iteration).

Programming: While rigorous theory is at the heart of any successful numerical method, we will also emphasize the hands-on implementation of the methods. Students will gain practical programming experience in implementing the methods using MATLAB. The use of MATLAB for homework assignments is mandatory. We will also discuss some practical considerations of implementing numerical methods using FORTRAN, C or C++.

Grades: Homeworks (40%), a midterm(30%) and final exam(30%).