MATH 5371
Numerical Linear Algebra
MW 4:00-5:20pm in PKH 105

Instructor: Prof. Ren-Cang Li, 445 PKH, (817) 272-0548, rcli@uta.edu

Class Home Page: http://www.uta.edu/faculty/rcli/Teaching/math5371/f2009

Office Hours: MW 2:00-2:50 or by appointment

Text: James Demmel, *Applied Numerical Linear Algebra*, SIAM, 1997.

Prerequisites: Good knowledge of linear algebra at a level of MATH 3319 or equivalent, some programming experience.

Grading: Homework and program: 30%, Mid-term 30%, Final: 40%. Time: TBA.

Homework or programs turned in up to one day late will receive 80% credit, only 50% credit after one day late. However, if there is a compelling reason; please contact me in advance, if possible. I will give you an extension for serious health problems, job interviews, or a similar serious situation.

You may work together on homework, but it should be turned in individually. On the other hand, it is all right to discuss programs with one another, but work should be done individually. Programs will be of two kinds, Fortran, C or C++ (your choice), and MATLAB. Assignments to be written in Fortran/C/C++ will use subroutines from the libraries LAPACK, CLAPACK, LINPACK or EISPACK. MATLAB is an interactive, user-friendly interface to a large body of numerical and graphics software, including linear algebra, and is widely used for testing and prototyping algorithms. You may find it convenient to do mixed language programming (e.g. calling a Fortran routine from C or C++, or a C routine from MATLAB).

While I reserve the right to raise grades, as a rule having the following percent of the scaled points will earn a grade of

Grade	Minimum %
A	85
B	70
C	50

Computer Resources: Access to a computer on which an almost recent version of MATLAB runs is essential for this course. MATLAB has an extensive on-line help facility (just type "help" or "help commandname" in MATLAB). An out-of-date, but still very useful, MATLAB introduction is available from the class webpage.

The Free Software Foundation's Matlab clone called **Octave** may also be used by those who do not have access to MATLAB. Octave works on Linux and Microsoft Windows.

Syllabus:
This course is concerned with the numerical solution of matrix problems in three standard categories:

- systems of linear equations,
- best approximation by least squares,
- eigenvalues, singular values, and corresponding vectors.

Basic considerations relevant to a variety of numerical problems will be explored for those three categories. Among these considerations are

1. matrix factorizations and canonical forms,
2. perturbation theory and condition-numbers,
3. effects of finite precision and range upon algorithms,
4. analyzing an algorithm's speed, and
5. mathematical engineering of numerical software.

Other Reading

1. *Fundamentals of Matrix Computations*, David Watkins, Wiley, 2002.
   Very readable beginning graduate level textbook.
2. *Matrix Computations*, C. Golub and C. Van Loan, 3rd Ed. Johns Hopkins Press 1996.
   Very complete, if not encyclopedic, book on dense matrix computations.
3. *Numerical Solution for Least Squares Problems*, Åke, Björck. SIAM, 1996.
   Most up to date survey of methods for linear unconstrained and constrained least squares problems
4. *The Symmetric Eigenvalue Problem*, B. Parlett, SIAM, 1998.
   Algebraic and analytic theory of symmetric matrices and algorithms