Course Outline: Fall 2012

University of Saskatchewan
Department of Mathematics and Statistics

NUMERICAL ANALYSIS II (MATH 313)

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Prerequisites: MATH 211; MATH 266 or an equivalent course in linear algebra
Text: L.N. Trefethen and D. Bau, III, *Numerical Linear Algebra* (Society for Industrial and Applied Mathematics, 1997).

Course Objectives: Numerical linear algebra is an incredibly common part of scientific computing. Traditional applications such as the numerical solution of ordinary differential equations, partial differential equations, or optimization problems are important examples. However, the importance of numerical linear algebra is paramount in seemingly unrelated yet extremely exciting areas such as computer graphics and animation, intelligent search engines, machine learning, computer vision, image processing, and system design and control (to name but a few). This course provides a fundamental framework within which to understand the issues and algorithms behind numerical linear algebra, thus making it a critical part to a comprehensive modern undergraduate training in science and engineering. Examples of parallel implementations of algorithms will be given. The use of the software packages Maple, Mathematica, and/or Matlab will be required.

I. Fundamentals

a. Matrix multiplication; orthogonal matrices; norms
b. The singular value decomposition
c. Projectors; **QR** factorization; Gram-Schmidt orthogonalization
d. Least-squares problems
e. Conditioning and condition numbers
f. Floating-point arithmetic; roundoff error
g. Stability of algorithms

II. Systems of Linear Equations

a. Gauss elimination, pivoting, $\mathbf{PA} = \mathbf{LU}$
b. Symmetric matrices; positive definite matrices; Cholesky factorization

III. Eigenvalue Problems

a. Eigenvalues and eigenvectors; matrix diagonalization
b. Power method; inverse iteration; unshifted and shifted **QR** algorithm

Activities for Evaluation:

- Assignments (4): 20 %
- Mid-Term Test (Thursday, October 25, 2012, in class): 25 %
- Final Examination: 55 %

Important Regulations

- All students must be properly registered in order to attend lectures and receive credit for this course.
- Failure to complete the assigned course work or to write the final examination will result in a failing grade for the course.
- Failure to obtain a mark of at least 40% on the final examination will result in a failing grade for the course.
- The course website lists other regulations regarding examinations, assignments, and academic honesty.