AMSC/CMSC 666 - Section 0101 (Spring 2002)

NUMERICAL ANALYSIS I

MTH 0101 - TuTh 11-12:15

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Objectives: This course is an introduction to four basic topics in numerical analysis. We will discuss statement and properties of mathematical problems, numerical algorithms for their solution, and examine crucial issues such as domains of applicability, stability, rates of convergence, and computational complexity.

Course Outline

1. Interpolation and Approximation Theory (3 to 4 weeks)
   Lagrange interpolation, Newton form, divided differences
   Error analysis, Chebyshev polynomials, Jackson Theorem
   Uniform approximation, Weierstrass's Theorem and Bernstein polynomials
   Piecewise polynomial interpolation (Lagrange and Hermite), cubic splines, error analysis
   Least squares, normal equations, orthogonal polynomials, QR factorization, singular value decomposition
2. Quadrature (2 weeks)
   Peano Kernel and Euler-MacLaurin expansion
   Extrapolation and Romberg integration
   Adaptive quadrature
   Gaussian quadrature
3. Eigenvalue Problems (3 to 4 weeks)
   Similarity transformations
   Rayleigh quotiens
   Power and inverse power methods
   Householder transformations
   QR algorithm, shift and deflation, convergence
   Singular value decomposition
4. Iterative Methods for Linear Systems of Equations (3 to 4 weeks)
   Classical methods: Jacobi, Gauss-Seidel, SOR, convergence
   Krylov sequence methods, conjugate gradient method, GMRES, preconditioning, convergence.

Grading Policy: Course grades will be based on homeworks (50%), a midterm exam (20%) and a final exam (30%).

Homeworks: They will consist of several problems to develop by hand (or word processor) and a few computing problems (projects). They will be mostly theoretical, with about 20% of computations using MATLAB. Instructions as to how to present your homework, which you must strictly adhere to, can be found in

`http://www.math.umd.edu/ omar/AMSC666/`

All homework will be submitted electronically, and the date of the e-mail will be used as submission date. Late homework will receive a penalty of 10% for up to 2 weekdays late, and 20% for up to 5 weekdays late. Homeworks which are overdue for more than 5 weekdays will not be accepted.
A useful elementary introduction to MATLAB by J. Cooper is found at `http://www.math.umd.edu/~jec`

References

A. Quarteroni, R. Sacco, and F. Saleri, *Numerical Mathematics*, Springer-Verlag, New York, 2000; ISBN 0-387-98959-5.

J. Stoer and R. Bulirsch, *Introduction to Numerical Analysis*, Springer-Verlag, New York, 1993.
K. Atkinson, *An Introduction to Numerical Analysis*, Wiley, 1989.
C. de Boor, *A Practical Guide to Splines*, Springer-Verlag, 1978.
P.J. Davis, *Interpolation and Approximation*, Dover, 1975.
G. Golub and C. van Loan, *Matrix Computations*, Johns Hopkins University Press, 1989.
G.W. Stewart, *Afternotes goes to Graduate School*, SIAM, 1998.