CS/MATH 3414 Fall, 2001
MW 8:00–8:50 MCB 126
CRN #91313 or 93351 F 8:00 MCB 118
CRN #91314 or 93352 F 12:20 MCB 118
`http://courses.cs.vt.edu/~cs3414/F01/`

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Prerequisites:

MATH 2214, MATH 2224, some knowledge of FORTRAN and UNIX.

Topics Covered:

0 - linear algebra, norms, inner products
1 - floating point arithmetic
2 - linear systems
3 - interpolation
4 - roots of nonlinear equations
5 - integration
6 - least squares
7 - cubic splines and approximation
8 - ordinary differential equations
9 - eigenvalue problems

Text:

R. D. Skeel and J. B. Keiper, Elementary Numerical Computing with Mathematica, Stipes, 2001.

References:

Burden, Faires, Reynolds, Numerical Analysis, Prindle, Weber, & Schmidt, 1981.
Cheney and Kincaid, Numerical Mathematics and Computing, Brooks/Cole, 1980.
Conte and deBoor, Elementary Numerical Analysis, Prentice-Hall, 1980.
Dahlquist, Numerical Methods, Prentice-Hall, 1974.
Forsythe, Malcolm, Moler, Computer Methods for Mathematical Computations, Prentice-Hall, 1977.
Forsythe and Moler, Computer Solution of Linear Algebraic Systems, Prentice-Hall, 1967.
Hamming, Introduction to Applied Numerical Analysis, McGraw-Hill, 1971.
Hamming, Numerical Methods for Scientists and Engineers, McGraw-Hill, 1973.
Henrici, Elements of Numerical Analysis, Wiley, 1964.
Hildebrand, Introduction to Numerical Analysis, McGraw-Hill, 1974.
Hornbeck, Numerical Methods, Quantum, 1975.
Isaacson and Keller, Analysis of Numerical Methods, Wiley, 1966.
Johnson and Riess, Numerical Analysis, Addison-Wesley, 1977.
Johnston, Numerical Methods, Wiley, 1982.
Kahaner, Moler, and Nash, Numerical Methods and Software, Prentice-Hall, 1989.
Mathews, Numerical Methods, Prentice-Hall, 1987.
Meissner, Fortran 90, PWS, 1995.
Ortega, Poole, Numerical Methods for Differential Equations, Pitman, 1981.
Ralston, A First Course in Numerical Analysis, McGraw-Hill, 1978.
Shampine and Allen, Numerical Computing, Saunders, 1973.

L.F. Shampine, R.C. Allen, Jr., and S. Pruess, Fundamentals of Numerical Computing, Wiley, 1997.

R. D. Skeel and J. B. Keiper, Elementary Numerical Computing with Mathematica, McGraw-Hill, 1993.

Stark, Introduction to Numerical Methods, 1970.

S. Wolfram, Mathematica, 2nd ed., Addison-Wesley, 1991.

Office Hours:

9:00–9:50 MWF, and by appointment.

Grading:

Course grade = two exams ($\approx 50\%$) + homework/programs/quizzes ($\approx 25\%$) + final ($\approx 25\%$). Late homework will not be routinely accepted, and its value decreases by a factor of 1/2 per day or fraction thereof. Grading typically follows approximately a Gamma distribution. The comprehensive final exam will be held on Monday, December 17, 2001 at 1:05–3:05pm.

Honor System:

The Honor System applies to this course. See the statement from the Department of Computer Science at http://www.cs.vt.edu/academics/ugrad/Handbook/koof.html. If in doubt about what is permissible, please ask.

Programming Languages:

FORTRAN 90 and Mathematica.

Computer System:

DEC Alpha or other UNIX-based workstations. Mathematical software for the assignments will be available in the McBryde 116/118 Undergraduate Computing Laboratory.

Programming Assistance:

Contact the consultants in McBryde or the GTA for the course.

Note:

I will make every effort to make this course enjoyable and profitable to you. However, "numerical analysis is not a spectator sport." You must have a positive attitude toward computer science, mathematics, theory, and the pursuit of knowledge. I can present, clarify, and query, but I cannot learn for you. *You* must make the effort to learn. For example, you should study your notes, read your text, and use the library without being reminded.

Supplementary Reading – CS/MATH 3414

Norms, inner products: Shampine, Allen – pp. 43-51; Conte, deBoor – 142-149, 246-254 (2nd ed.), pp. 169-176, 251-258 (3rd ed.); Dahlquist – pp. 85-92.

Floating point arithmetic: Conte, deBoor – pp. 1-12 (2nd ed.), pp. 1-19 (3rd ed.); Dahlquist – pp. 42-49; Shampine, Allen – pp. 7-22; Forsythe, Moler – pp. 87-91; Forsythe, Malcolm, Moler – pp. 10-23.

Linear systems: Dahlquist – pp. 137-160; Shampine, Allen – pp. 145-161; Isaacson, Keller – pp. 26-33; Conte, deBoor – pp. 91-150 (2nd ed.), pp. 128-188 (3rd ed.); Forsythe, Malcolm, Moler – Chapter 3.

Interpolation: Shampine, Allen – pp. 26-38; Conte, deBoor – pp. 191-212 (2nd ed.), pp. 31-69, 221-229 (3rd ed.); Dahlquist – pp. 275-286; Isaacson, Keller – pp. 245-253, 187-193.

Nonlinear equations: Conte, deBoor – pp. 27-34, 57-73 (2nd ed.), pp. 72-88, 100-119 (3rd ed.); Shampine, Allen – pp. 87-102; Dahlquist - pp. 218-233; Forsythe, Malcolm, Moler – pp. 156-161.

Integration: Conte, deBoor – pp. 284-317 (2nd ed.), pp. 303-344 (3rd ed.); Shampine, Allen – pp. 64-80; Dahlquist - pp. 290-304; Forsythe, Malcolm, Moler – pp. 84-101.

Least squares: Conte, deBoor – pp. 241-264 (2nd ed.), pp. 245-267 (3rd ed.); Shampine, Allen – pp. 43-51; Dahlquist – pp. 87-94; Isaacson, Keller – pp. 194-205, 211-217.

Splines and approximation: Conte, deBoor – pp. 230-240 (2nd ed.), pp. 284-293 (3rd ed.); Shampine, Allen – pp. 54-60; Dahlquist – pp. 131-135; Forsythe, Malcolm, Moler – pp. 70-79.

Ordinary differential equations: Conte, deBoor – pp. 319-356 (2nd ed.), pp. 346-388 (3rd ed.); Shampine, Allen – pp. 109-143; Dahlquist – pp. 330-348; Forsythe, Malcolm, Moler – pp. 110-147.

Eigenvalues: Conte, deBoor – pp. 170-180 (2nd ed.), pp. 185-206 (3rd ed.); Dahlquist – pp. 208-217.