Numerical Approximation and Discretization
CPSC 303, Term 2, Winter 2005–2006

Course Details

Web Page: `http://www.ugrad.cs.ubc.ca/~cs303/`

Newsgroup: `ubc.courses.cpsc.303`

Lectures: 11:00–12:00, Monday/Wednesday/Friday, Dempster 110.

Instructor: Ian Mitchell, `mitchell@cs.ubc.ca`, ICICS 217.

Teaching Assistants: Kangkang Yin, `kkyin@cs.ubc.ca` and Jelena Sirovljevic, `jelenas@cs.ubc.ca`.

Grading: 4–6 homework assignments (20%), 2 midterms (30%), 1 final (50%). Midterms will tentatively occur in weeks 5 and 9.

Textbook: *Scientific Computing: An Introductory Survey* (second edition) by Michael T. Heath, available at the bookstore.

Course Notes: *A First Course on Numerical Methods* by Uri M. Ascher and Chen Greif, available from the course web page.

Prerequisites: All of MATH 200 (Calculus III) and MATH 221 (Matrix Algebra). One of CPSC 111 (Introduction to Computation) or CPSC 260 (Object-Oriented Program Design) or the no longer offered CPSC 122, CPSC 126 or CPSC 152. Homework assignments will require some programming in MATLAB, which is easy to pick up if you have experience in C, C++, Java or Fortran.

Homework collaboration policy: You may collaborate with other students in the class on homework questions prior to writing up the version that you will submit. This collaboration may include pseudo-code solutions to programming components. Once you begin writing the version that you will submit, you may no longer collaborate on that question, either by discussing the solution with other students, showing your solution to other students, or looking at the solutions written by other students. You may **never** share executable code (including MATLAB m-files) for homework questions.

You may seek help from the course instructor or TA at any time while preparing your homework solutions. You may not receive help from any other person.

If you feel that you have broken this collaboration policy, you may specify in your homework solution the name of the person from whom you received help and what components of that help you feel were beyond the limits of this collaboration policy, in which case your grade will be suitably adjusted to take this collaboration into account. If you break this collaboration policy and fail to cite your collaborator, you will be charged with plagarism as outlined in the university calendar. If you have any questions or if you believe that other students have been breaking this policy, please contact the instructor.

Tentative Outline: Chapters are from Heath (H) and Ascher & Greif (AG).

- Numerical algorithms and roundoff errors (H 1; AG 1–2).
  - Numerical analysis and the art of scientific computing.
  - Numerical algorithms and errors.
  - Round-off errors and computer arithmetic.
- Interpolating approximations (H 7; AG 10–11).
  - Polynomial interpolation.
  - Lagrange polynomials.
  - Divided differences and Newton's form.
  - Osculating (Hermite) interpolation.
  - Piecewise polynomials and spline interpolation.
  - Parametric curves.
- Best Approximation (H 3, 7, 12; AG 12–13).
  - Least squares data fitting.
  - Orthogonal polynomials and least squares approximation.
  - Chebyshev polynomials.
  - Trigonometric interpolation and the Fast Fourier Transform.
- Numerical Differentiation and Integration (H 8; AG 14–15).
  - Numerical differentiation.
  - Roundoff and data errors in numerical differentiation.
  - Basic quadrature algorithms.
  - Composite numerical integration.
  - Romberg integration and adaptive quadrature.
  - Gaussian quadrature.
- Numerical solution of Initial Value Ordinary Differential Equations (H 9; AG 16).
  - Initial value problems.
  - Euler's method.
  - Runge-Kutta methods.
  - Error control.
  - Multistep methods.
  - Absolute stability and stiffness.