Lecturer: Christina Christara (ccc@cs.toronto.edu)
Lectures: Monday 1-3 PM, Room MP 118
Tutorial: Thursday 2-3 PM, Room BA 4010 (some tutorials used for lectures)
Office Hours: Monday 3:30-4:30 PM, Room BA 4226, other hours by appointment
more hours will be posted depending on assignments and exams
a reduced version, appropriate for the course, is available in Bookstore (Custom Publishing)
Bulletin board: https://csc.cdf.toronto.edu/csc436h1f

Aims of course
Formulate numerical methods for approximation, integration, eigenproblems and ODEs.
Evaluate numerical methods with respect to their convergence, stability, and efficiency.
Develop and practice computer skills in implementing numerical methods efficiently on the computer.
Use high level software for studying numerical methods.

Skills / Knowledge testing in the course
Apply basic principles, not recall lecture notes in detail
Problem recognition
Method recognition
Apply a given method correctly
Solve a numerical problem efficiently and reliably using mathematical software.
Judge the quality and efficiency of the results.

Prerequisite Mathematics and Numerical Analysis
Ability to handle notation and to do algebraic manipulation
Induction
Calculus including
Differentiation and integration of polynomial, trigonometric, exponential, logarithmic and rational functions, continuity, limits, graphs of functions, Taylor series, Rolle’s theorem, mean-value theorem, de l’ Hospital’s rule, some exposure to multivariate differentiation, etc.
Elementary Linear Algebra including:
Matrix and vector addition and multiplication, elementary row operations, linear (in)dependence, inverse matrix, etc.
Numerical Linear Algebra (such as CSC336 or CSC350) including:
Linear solvers for banded matrices
Nonlinear equations solvers
Computational methods: Understanding of round-off error, computer arithmetic, etc.
Programming: knowledge of some programming language, such as MATLAB, FORTRAN or C.

Computer accounts
You will get (or have already) a computer account on the CDF Unix system. Consoles/workstations are located in the Bahen building. You must log-in frequently and read mail, news and other messages relating to the course through your account.

Marks distribution

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Due Date</th>
<th>Weight</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>Thursday, October 13</td>
<td>12%</td>
<td>Must get at least 33% in the final exam.</td>
</tr>
<tr>
<td>Term test</td>
<td>Thursday, October 27</td>
<td>20%</td>
<td>Must get at least 33% average in the computer assignments.</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>Due Monday, November 14</td>
<td>12%</td>
<td></td>
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<tr>
<td>Assignment 3</td>
<td>Due Wednesday, December 7</td>
<td>12%</td>
<td>Midterm test and Final exam: Calculators are the only aids permitted.</td>
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<tr>
<td>Final exam</td>
<td>2 hours</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>Class participation</td>
<td></td>
<td>8%</td>
<td></td>
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</tbody>
</table>
Problems sets / Computer assignments

Problem sets: please write as clearly as possible.

Indicate your last (family) name by capitalisation or underlining in the front page of your paper.

Computer assignments: don’t leave it to the last minute - think of the following

- the machine being down, when you need it.
- the workstation room being crowded.
- the printer being stuck, when you are just at the time to get your final listing.
- accidentally deleting an important file.

overcome this by using backup procedures (for the source and data files only).

The above are not good reasons for extension of the assignment due date.

Late assignment policy

Assignments are due the day posted, at lecture time. Assignments submitted late have a reduction of marks based on the maximum total marks the assignment could get, had it been submitted on time (and not on the total marks the assignment actually got). Each day costs 10%, to a maximum of 5 days. Assignments submitted later than 5 days after the due date do not receive any marks. Weekends and holidays count as regular days for the purpose of late assignment policy.

Topics to be covered

- Interpolation (Ch. 7)
  Polynomial interpolation - Weierstrass theorem
  Monomial basis, Lagrange basis, Newton’s divided differences
  Existence and uniqueness of interpolating polynomial
  Error of polynomial interpolation
  Evaluation of a polynomial - Horner’s rule
  Polynomial interpolation with derivative data - Hermite interp.
  Monomial basis, Lagrange basis, Newton’s divided differences
  Existence and uniqueness of Hermite interpolating polynomial
  Error of Hermite polynomial interpolation
  Problems with polynomial interpolation - Runge’s function
  Piecewise polynomial interpolation - splines
  Basis for piecewise polynomials

- Least Squares Approximation (Ch. 3)
  Least squares problems - data fitting
  Inner products and norms of functions
  Normal equations, QR factorisation, Gram-Schmidt algorithm
  Orthogonal and orthonormal polynomials

- Computing eigenvalues and eigenvectors (Ch. 4)
  The power method; the QR iteration

- Integration -- Quadrature (Ch. 8)
  Simple quadrature rules - rectangle, midpoint, trapezoidal,
  Simpson’s, corrected trapezoidal
  Gauss quadrature rules
  Compound quadrature rules
  Romberg integration
  Adaptive integration
  Infinite integrals, singularities

- Ordinary Differential Equations (Ch. 9)
  Initial Value Problems and Boundary Value Problems
  Stability of ODEs and of methods for ODEs
  Euler’s method
  Implicit methods, backward Euler’s and trapezoidal method
  Runge-Kutta methods
  Taylor’s series methods
  Linear Multistep Methods

Other references

Richard L. Burden and J. Douglas Faires,
Numerical Analysis,
Brooks/Cole

David Kincaid and Ward Cheney
Numerical Analysis
Brooks/Cole

James Epperson
An introduction to Numerical Methods and Analysis
Wiley 2003

L. W. Johnson and R. D. Riess
Numerical Analysis
Addison Wesley

S. D. Conte and Carl de Boor
Elementary Numerical Analysis
McGraw-Hill Inc.

G. Dahlquist and A. Bjorck (trans. N. Anderson)
Numerical Methods
Prentice Hall

J. Stoer and R. Bulirsch
Introduction to Numerical Analysis
Springer Verlag

I have ordered a custom-made copy of the Heath book that costs about $75, at the UT Bookstore. This is the same book used for CSC336 and CSC350. The Heath book covers most of the material of CSC436. Books such as the Kincaid and Cheney and the Burden and Faires books, cover similar material (some topics are more condensed than the Heath one, and some more expanded). It may be useful to consult these other books occasionally. All these books are reserved in the library.