CSC 260: Introduction to Scientific, Symbolic, and Graphical Computation

Department of Computer Science, University of Toronto, Spring 1999

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Classes: Lectures are in MP 134, Mondays and Wednesdays from 2:10 to 3:00, starting January 4.

Tutorials are held Fridays from 2:10 to 3:00, starting January 15. You are expected to know the material presented in tutorials. Tutorial assignments and rooms will be determined after the first week of lectures.

There are no lectures or tutorials during Reading Week, February 15 to 19. There are no tutorials on Good Friday, April 2.

The last lecture is on April 7. The last tutorial is on April 9.

Computing: The course will use the Maple language on the CDF Unix computers in the Engineering Annex. If you do not already have a permanent account on CDF, you will get one for this course.

Course web page: `http://www.cs.utoronto.ca/~radford/csc260/`

Books: There is no required text for this course. Copies of the lecture slides will be available at cost.

The following book is recommended, as it covers roughly the same topics: *An Introduction to Scientific, Symbolic, and Graphical Computation*, by Eugene Fiume.

You may also wish to purchase Maple V documentation, such as the *Maple V Learning Guide* and/or the *Maple V Programming Guide*. Maple has extensive on-line help, however, so buying these books is not absolutely necessary.

You will also need *A Student's Guide to CDF*, by J. Clarke, available in the bookstore. Any of various books on the Unix operating system may also prove useful.

Purpose of the Course

This course is an introduction to how computers can be used to implement mathematical models that reflect reality or that behave in some desirable way. More specifically, we will study

- Two types of computation: *symbolic* computation, such as the sort of algebraic manipulation that you are probably used to doing with pencil and paper, and *numeric* computation, such as you are used to doing with a calculator.
- Symbolic and numerical methods for solving several types of problems, such as *interpolation* of data points, *finding zeros* of a function, *integration* of functions, and *filtering* of signals.
- How these methods can be implemented in the Maple V programming language, as well as the built-in facilities that Maple provides.
- How such methods can be used to solve problems involving mathematical modeling, such as arise in computer graphics.

Grading Scheme

Assignments:	30%	Tentatively three, each worth 10%.
Mini-tests:	24%	Tentatively three, each worth 8%, held in tutorial for 30 minutes, followed by discussion of solutions.
Final exam:	46%	To be scheduled by the Faculty of Arts and Science

To pass the course, you must receive a mark of at least 30% on the final exam.

Policies

- Late assignments will not be accepted for grading except in the case of illness or other valid excuse. If you have a legitimate reason for not being able to complete an assignment by the specified due date, you should if possible talk to me *before* the assignment is due.
- The assignments are to be solved by each student individually. You may discuss an assignment in general terms with other students, but this should not amount to getting another person to solve it for you. You should not leave such a discussion with written material provided by or copied from another person.

  Failure to comply with these guidelines is a serious academic offense.
- Interfering with the operation of the computer system, or with the work of students using it, is also a serious breach of academic discipline.
- If you disagree with the mark you have received on an assignment or the mid-term test, you should discuss the problem with with me within *one month* of when the work was returned. Requests to review marks after this will not be considered.
- Barring contingencies that I can't at present imagine, the final mark will be computed by averaging the marks on the assignments and exams, with the weightings given above. If an assignment or exam turns out to be easier or harder than intended, the marks given for it may be adjusted. You will be told the adjusted mark when the work is returned to you.

Tentative Course Outline

Jan	4	Topics we will cover; examples of symbolic and numeric computation in Maple.
	11	Exact, fixed-point, and floating-point representations of numbers; rounding errors.
	18	Approximating functions by Taylor series and other methods; evaluating polynomials.
		First mini-test January 22
		Assignment 1 handed out, due February 12
	25	Explicit, implicit, and parametric representations of curves and surfaces.
Feb	1	Rendering lines and curves for computer display.
	8	Solving differential equations; dynamical simulations.
		Second mini-test February 12
	15	READING WEEK (no classes)
	22	Lagrange and piecewise polynomial interpolation; natural cubic splines; basis functions.
		Assignment 2 handed out, due March 19
Mar	1	Finding zeros of functions symbolically and numerically.
	8	Integrating functions symbolically and numerically.
	15	Multidimensional integration with product rules and by Monte Carlo.
		Third mini-test March 19
		Assignment 3 handed out, due April 9
	22	Approximation using Fourier series; generating random fractal functions.
	29	Fourier transforms, convolution, sampling, and filtering
Apr	5	Review and examples.