Math 364 - Introduction to Scientific Computing

2 2-unit Modules, 7 weeks each, Fall 2005

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Syllabus

Course Description

This module is intended to help students develop a basic competence in scientific computing. Students will be given a high level introduction to computing in MATLAB and LaTeX. A broad collection of basic numerical techniques will be presented, including approximation methods, iterative methods for root finding, linear algebra applications solving matrix-vector problems and linear systems. The second module will include more advanced MATLAB topics, some database management and some open source software mySQL, Perl, R.

Course Teaching Objectives

This course is designed to enable students to

1. Develop computing proficiency by learning and implementing the methods described above on the computer.
2. Develop problem-solving skills
3. Improve mathematical skills

Course Learning Objectives

Students completing this module will be able to

1. Demonstrate a basic competence in scientific computing
2. Work on a mathematics clinic and other work in industrial applied mathematics
3. Design computer algorithms to solve mathematical problems.

Introduction:

The applications listed in the course description are only a few out of many applications of mathematical algorithms. The study of algorithms began as a subject in mathematics and in fact, the search for algorithms has been an important activity of mathematicians long before the development of today's computers. The task of discovering an algorithm for solving a problem is essentially discovering a solution for the problem. Using mathematics computer software such as MATLAB provides the student with a powerful tool to solve mathematics and engineering problems that do not necessarily have an analytic solution. These are called numerical methods. For instance, to be able to find the solution of an integral by approximation methods or, to see how a mathematical function looks like, or to manipulate thousands of data and turn that data into information, are some of the skills that the student will develop by taking this module.

Prerequisites:
Graduate standing in the mathematics program, or permission of instructor, and basic competence with the Windows operating system. Concurrent enrollment in the mathematics clinic is welcomed. Students who already have credit for courses at CGU or the Claremont Colleges that make heavy use of MATLAB will not be allowed to enroll for credit.

Course Materials/Software:
Copies of MATLAB will be available for use on both of the math houses. Students wishing to use MATLAB on their home computers may purchase copies of the student edition of MATLAB from the Huntley Bookstore (price is ~$99.89 and the package includes two books), or by ordering from www.mathworks.com. Alternatively, the program "Octave", a near compatible version of MATLAB 4.2, is free for installation on your own computer (under General Public License), and available for Windows 95 and above at the web site http://members.localnet.com/~tomcw/

The following texts are recommended:
1) Cleve Moler. Numerical Computing with MATLAB. Publisher SIAM. ISBN: 0-89871-560-1
2) Brookshear J.G. Computer Science: an overview. Addison Wesley 7th Ed. ISBN 0-201-78130-1
3) Griffiths, D.F. and Higham, D.J. Learning LaTeX. Philadelphia: SIAM.ISBN 0-89871-383-8
4) Higham, D.J. and Higham, N.J. MATLAB Guide. Philadelphia: SIAM. (For ordering information, see: http://www.siam.org/catalog/mcc06/ot75.htm)
5) Hornbeck, R.W. Numerical Methods. New Jersey: Prentice Hall/Quantum.

The first one will be used as a textbook and 4th of these serves as a reference for the MATLAB language and its capabilities. Reference (5) describes a broad array of numerical methods that will be discussed in the course.

Evaluation:
Grades will be based on homework (60%) a term project and/or final exam (40%). For the homework 3 parts will be equally graded: problem solution description, code, and explanation of the results. For the term project, students will be required to define and solve a challenging mathematics problem using computing in the MATLAB environment. A written report in LaTeX containing the project description, algorithms used, computer program listing, and sample outputs will be submitted, and each student will deliver a brief oral presentation of his or her project. Students are allowed to work in group BUT homework should be turned in individually. Problems with identical solution will worth 0 points and plagiarism will be highly penalized. If plagiarism is proven it will be documented in your file, two documented instances would lead to expulsion from CGU and failure of the course.

Office Hours:

• Wednesday 3:00 - 4:30pm at Math South
• By e-mail at Claudia.Rangel@cgu.edu

Tentative Calendar

Date	Lecture	Assignment *due Thursdays before 6:00pm*
August 30th	Ch1: Introduction to MATLAB	**Student Information form**
September 6th	Introduction to LaTeX	Assignment #1
September 13th	Ch 2: Linear Equations	Assignment #2 in LaTeX
September 20th	Ch 3: Interpolation	Assignment #3 & Project proposal both in LaTeX
September 27th	Ch 4: Zero Finding	Assignment #4
October 4th	Ch 9: Random Numbers	---
October 11th	Applications	Assignment #5
October 18th	*Project Presentations*	*Talk*
October 25th	Introduction to Databases	Project
November 1st	SQL	Assignment #6
November 8th	Ch 5: Least Squares	Assignment #7
November 15th	Invited lecture : **SAS**	Assignment #8
November 22nd	Ch 10: Eigenvalues and Singular values	
November 29th	Open Source Software	Assignment #9
December 6th	Interesting Topics & Review	Assignment #10 **Course Evaluation form**
December 13th	*Final Exam*	