Physics 606

Techniques of Computational Physics

Welcome to the Techniques of Computational Physics course web page. This course is offered Fall Semester 2002. Here we will provide information about the course as well as materials. Both lecture materials and other background materials will be provided as the course developes.

Note that we intend to make extensive use of this web page. Please refer to it on a regular basis for occasional extra materials, lecture notes, and hand-outs. The url for this web page is:

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http://chandra.bgsu.edu/~gcd/p606-2002.html

Course Instructor:

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My email address is: gcd@chandra.bgsu.edu

Course Information

Course Materials:

- Hand-outs on various computational physics methods will be provided.
- When possible, links in this web page to the lectures and selected hand-outs will be made as the term proceeds.
- A bibliography of some key references will be provided.

Course Objectives:

This course is an introduction to the methods of computational physics for graduate students. The emphasis will be on the development of tools useful in formulating and solving problems in the physical sciences. Among the topics to be covered are:

- Unix
- Some Numerical Methods for Ordinary differential equations
- Hyperbolic Partial Differential Equations
- Introdution to Computational Fluid Dynamics
- Introduction to Parallel Computing
- Introduction to the Message Passing Interface (MPI) used to develop and run parallel computing applications
- Introduction to Cluster Computing

- Fortran programming as used in all programming of the computational physics. There is a good treatment of fortran 90 for the fortran 77 programmer which you should consult when needed.

There may be other topics that can be covered. We shall tailor the topics somewhat to the interests of the students and instructor.

The course will meet on Mondays and Wednesdays from 7:30 to 8:45 p.m. in the Conference Room in the Department of Physics and Astronomy in room 106 of Overman Hall.

Tentative Course Syllabus for Fall Semester 2002

Topic	Weeks	Notes
Introduction to Unix	1 week	
Finite Difference Approximations for Derivatives	1 week	
Introduction to Fortran 90	2 weeks	
Numerical Methods for Ordinary Differential Equations with examples in f90	2 weeks	
Numerical Solution of One-dimensional Wave Equation with examples in f90	1 week	
Numerical Solution of Two-dimensional Wave Equations plus Boundary Conditions in f90	1 week	
Introduction to Parallel Computing on Linux Clusters (OSC on-site training plus worked applications)	2 weeks	
Using MPI to implement the distributed computing solution of the 2d wave equation in f90	2 weeks	
Introduction to Computational Fluid Dynamics--basic treatments and methods	2 weeks	

Using MPI to implement the distributed computing solution of 2d fluid dynamical systems	2 weeks	

Requirements for the course:

A knowledge of Physics at the undergraduate level is assumed. Further study in mathematics would be helpful. If you already know a high level language [such as C, C++, fortran] that will help. Mathematica may be a component in the course delivery. Also, matlab will be used for some post simulation graphics and data analysis. We intend that the student will learn enough matlab during the semester. The student will be expected to learn Mathematica and Matlab programming as needed. Both Mathematica and Matlab are available on the bgunix machines. Occasional discussion of these useful programs will be given as needed.

Examinations:

There will be several assigned problems in the form of computer programs which the student is to write after appropriate discussion in class on the computational topic. The due date of a given assignment will be announced when the assignment is made.

There will also be a required term project in computational physics to be completed and handed in on the day that the course would have its in class final examination. That date will be announced later in the term.

The grade for this course will be determined by taking the problem sets [assigned programs and exercises] as 50% and the term project as %50.