Syllabus
Physics 304b 2008
Computational Physics
Instructor: Peter Love
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Textbook and supplies

Computational Physics, N. J. Giordano and H. Nakanishi (2nd ed.) Prentice Hall
A selection of other texts and useful references is on reserve in the Science library.

Course Requirements:

Two one-and-one half hour class meetings per week. One computer lab recitation hour per week. Class periods will be devoted to lecture and programming exercises. Reading is required in addition to the material covered in class. Evaluation will be based on weekly problem sets, two exams and a six week project.

Course Description:

Physical theories such as Newtonian mechanics, Maxwell's equations and quantum mechanics give us simple descriptions of physical phenomena. Much of the undergraduate syllabus treats powerful analytical tools for the solution of the equations derived from the relevant physical law. Such solutions enable physicists to move from a general formalism to the description of specific situations and phenomena, and enable comparison with experiment. Frequently, however, the calculation of the behavior of specific physical systems is out of the reach of pencil and paper calculation. Computational physics enables us to treat such situations by a combination of brute force calculation and sophisticated algorithmic techniques.

The first eight weeks of the course will be devoted to lectures and exercises covering several aspects of computational physics. The course will begin by considering effects in Newtonian mechanics which are usually neglected, including air resistance in projectile motion and nonlinear and chaotic behavior of mechanical systems. We will learn how to use numerical simulation to study such effects. We will then turn to the numerical treatment of fields in physics, and consider the numerical solution of Poisson's equation. This enables the solution of problems in electromagnetism which possess insufficient symmetry for analytical treatment. The last portion of the lecture section of the course will move from deterministic algorithms to stochastic algorithms, and we shall consider the numerical treatment of systems in statistical mechanics using Monte Carlo techniques.

The remaining six weeks of the course will be devoted to a student project. Students may choose from a selection of pre-prepared projects or propose their own. The project will include:

1. Application of a numerical technique to the solution of a problem from physical science
2. Implementation of a new feature in a numerical calculation.
3. Execution of code and production of data
4. Analysis and presentation of the data, including consideration of the limitations of the numerical techniques and estimation of errors and uncertainties in the results

Assignments and Tests:

Written work will be due each week in class. There will also be assigned readings to prepare you for class discussion. It is essential for your understanding that you stay ahead of class in your readings. Some assignments will include so-called individual problems. It is expected that you work on these problems without collaborating with other students. You may ask questions of the instructor concerning these problems.
There will be two time-limited, take-home exams. Exams will cover both concepts and problem solving. Time pressure in exam settings, while not the goal of the instructor, is not entirely avoidable. You should prepare to be able to work efficiently on the material covered and avoid poor time management choices during the exams. Practice exams will be available beforehand, but remember that while poor performance on the practive exam guarantees

poor performance on the real exam, good performance on the practice exam does not guarantee good performance on the real exam. You should NOT use the practice exam as a guide to the detailed CONTENT of the real exam.

The project will be assessed based on a written report presented by the student and an oral examination.

Grading procedures:

Course grade – will be computed using the following weighting:
Written exercises 30%
First Exam 15%
Second Exam 15%
Project 40%

Exams: Credit will be given for displaying understanding and for correct execution of problem solutions. Partial completion of a problem will receive partial credit. Clear explanations of your work are required. Exams must be turned in not later than the stated times, except by prior agreement.
Late policy – You may have two "free extensions" of one week *on problem sets only* during the course of the semester. If you are taking a free extension please simply hand in a sheet of paper with your name and a note that you are taking a free extension. Please save them for when most needed, and remember that you do not have to take your extensions. The late policy extensions do not apply to the exams or final project. The project is due on the last day of class.
No other extensions will be granted except for a Deans excuse.

Honor Code Issues:

The important guiding principle of academic honesty is that you must never represent the work of another as your own. The following guidelines should govern your behavior in the course; please request clarification if you find yourself in any doubtful situations.
You may seek assistance for the Instructor or work together with other students (except on individual problems) in doing the weekly assigned exercises and in preparing for class discussions. If working with other students in the course avoid situations in which you are either contributing too much or too little to the collaborative effort. (Neither results in optimal learning, but are not violations of the honor code.) While working together is permitted and even expected and therefore does not need to be acknowledged, merely copying the work of another student without indicating that you have done so is clearly a representation of his or her work as your own and so is a violation of the code.
The exams must be entirely your own work. You must also follow all procedures and respect time limits without deviation.

Accommodations:

Students who think they may need accommodations in this course because of the impact of a disability are encouraged to meet with me privately early in the semester. Students should also contact Rick Webb, Coordinator, Office of Disabilities Services (rwebb@haverford.edu, 610-896-1290) to verify their eligibility for reasonable accommodations as soon as possible. Early contact will help to avoid unnecessary inconvenience and delays.