Physics 13: Scientific Computing and Visualization

Winter Study 2010

Location: Jesup 207
Time: MWF 1-3pm
Office Hours: by appointment

Instructor: Dr. Frederick W. Strauch
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Required Text: *None*
Optional Text: *Computational Physics* by N. J. Giordano and H. Nakanishi (on reserve in Schow)
Recommended: Computer with *Python, Matlab,* and *Mathematica*.

Course Overview

We will study a number of computational tools and techniques to model and visualize scientific processes. Each sessions we will carry out a series of computational exercises using Mathematica, matlab, Python, C, Fortran, and/or a computer language of the student's choice (no previous programming experience is required). These exercises will be drawn from mathematics, chemistry, biology, and physics. In addition, we will have a quick introduction to the typesetting program LaTeX, allowing for the preparation of professional scientific documents incorporating high-quality images. An effort will be made to allow each student to work on problems appropriate to his or her interests.

Course Goals

At the end of this course, you will be able to identify multiple computational methods to solve scientific problems. You will also gain proficiency in Python, Matlab, Mathematica, and Latex. Finally, you will develop skills in procedural programming and good coding practices for fun and profit.

Course Structure

Meetings: We will meet three times a week, during which you will be introduced to new computer methods and begin a set of programming exercises. You are encouraged to work with a partner, but for maximum benefit, you should attempt all of the exercises on your own first, meet to go over each other's code, and refine your work.

Final Project: During the final week of winter study, you will work on a final project of your own choosing (in consultation with the instructor, and either individually or with a partner). The purpose of this project is to put your skills into practice, by working through an extended exercise, by learning and using a new computational technique, or by working with a special computer program, language, or external library. You will write up your work in a brief technical report in TeX (with representative code and images), and give a brief presentation.

Grading

You are expected to submit your coding exercises and the final project.

Course Outline and Schedule

Session	Dates	Topic
1	Jan. 4	Overview and Intro. to Python
2	Jan. 6	Loops, Control, and Modules
3	Jan. 8	Recursion, Files, and Review
4	Jan. 11	Mathematica, Matlab, and Pylab
5	Jan. 13	Methods for Differential Equations
6	Jan. 15	Stochastic Methods
7	Jan. 18	Methods of Visualization and Intro. to LaTex
8	Jan. 20	Maps, Mandelbrot, and More
9	Jan. 22	Graphs, Matrices, and Molecules
10	Jan. 25	Final Project
11	Jan. 27	Final Project
12	Jan. 29	Final Project and Presentation

Honor Code

Every work that is done by you and your fellow students is subject to the honor code. Note that the honor code is not just about cheating: all activities in class are to be undertaken with honesty and integrity. However, this should not be pursued at the expense of learning. Your peers are a great resource, and you are greatly encouraged to discuss this class and all assignments with your fellow students. However, all submitted work must be your own. Significant collaboration with others should be acknowledged. If in doubt, contact me with your question.

Final Disclaimers

All contents of this syllabus are subject to revision by the instructor. While physics and programming is not usually a politically charged topic, passionate discussion may occasionally occur (e.g. Mac vs PC). Please do not take any perceived offense personally, and please see me if you have any concerns.