PHYS 3211 – Computational Physics and Programming I
Fall 2015

Professor:	Dr. Christopher Aubin, Freeman 111B
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Meeting Times:	W, 12:30 - 2:20 & F, 1:00 - 2:50 — Freeman 204
Office Hours:	TR 11:30 - 12:30, W 2:30 - 3:30, and by appointment
Required:	Cloud9 user account: `https://c9.io/`
Recommended:	*Numerical Recipes: The Art of Scientific Computing, 3rd Ed.*, `http://nr.com/`
	The 2nd edition (using C) is free at `http://apps.nrbook.com/c/index.html`.

The purpose of computing is insight, not numbers.

– R. W. Hamming

Course Description (from the bulletin)

An introductory course in the use of computers to numerically solve problems in physics. Topics include numerical solution of non-linear equations, interpolation and extrapolation, numerical differentiation and integration. No prior knowledge of computer language is required.

Other useful sources

There are a host of online resources for programming, and this is a small sample. If you find others that I haven't mentioned that you find useful, please let me know.

- `http://arxiv.org/abs/1506.02567`: Badis Ydri, *Introduction to Computational Physics and Monte Carlo Simulations of Matrix Field Theory.*

- `http://www.physics.ohio-state.edu/~ntg/6810/readings/Hjorth-Jensen_lectures2013.pdf`, Lecture notes from a computational physics course at Ohio State.

- `http://publications.gbdirect.co.uk/c_book/`, Online reference to programming in C++.

- There are plenty of C/C++ programming boooks around; I urge you to get a copy of one for cheap. A good reference is the Osbourne series, *C++: The Complete Reference* by Herbert Schildt.

- All of your undergraduate physics textbooks.

Grade Policy

Participation:	15%	Homeworks:	45%
Midterm Project:	15%	Final Project:	25%

Participation

This will be a hands-on learning environment, as we will be learning to code while actually coding, and your presence is essential. Of the 28 class meetings we will have, if you miss a couple of days, there will be no real negative impact on your grade. However, this includes "***excused***" absences. That is, if you are sick and miss a couple of days, this won't affect your grade unless you have other "unexcused" absences. There will be days that will be listed as "Lab Days" throughout the semester, and meant for you to work on things we've discussed in class.

Attendance will be taken during the first 15 minutes of class. If you are more than 15 minutes late you will be considered absent.

Homeworks

There will be weekly assignments in this course, to be turned in online. These will be done using the Cloud9 system mentioned above with very specific formatting instructions. Most of the time you will be turning in code that you will write, but there will be times you will have to answer specific questions about the results from your code.

In your home directory on Cloud9 you will create a directory called "HWN" where N is the particular assignment. In that directory you will put just the source codes of the programs you're asked to write (do not compile them!) and if there are written answers, you will call those text/PDF files problem1.txt/pdf, problem2.txt/pdf, *etc.* [NO WORD DOCUMENTS!]

Midterm Project

Your midterm project will take some of the algorithms learned during the first half of the semester and apply them to a physical project of your choosing. You will turn in your code as well as a 3-5 page write up of the physics of your project as well as the results. These write-ups will be distributed to your fellow classmates so they can learn about your project.

Final Project

You will have a final project in lieu of a final exam which will involve an independent project of your own choosing. It will be a computer simulation of a physics topic you find interesting. While they won't be due until the end of the semester, you will have to turn in your ideas by **Nov. 4** for approval. The project will involve a program that performs the simulation you wish as well as a 20 minute presentation on the physics you choose and the results of your simulation.

In-class Technology Policy

Obviously in this class you will be generally on the computer working on the course material. However, phones must still be silenced and put away, and only computer use related to the course (be it coding, looking at a relevant on-line resource, *etc.*) is allowed. No social media, email, or looking up cat videos allowed.

Topics to be covered (in no special order)

Basic Programming Techniques	Numerical Integration
Numerical Precision/Errors	Monte Carlo Sampling
Numerical Differentiation	Random Walks
Differential Equations	Non-linear equations, root finding
Linear Algebra/Eigensystems	Boundary Value Problems
Data fitting	

Computational Skills

Command line tools/Linux	C++ programming	LaTeX
Gnuplot	Cloud9 Workspace	Github

Important Dates:

Sept. 9:	No class (Mon Sched)	Oct. 6:	Tue class (Wed Sched)
Oct. 16:	Midterm Project due	Nov. 4:	Project ideas due
Nov. 25, 27:	No class (Thanksgiving)	Dec. 4, 9:	Project presentations