Computational Methods in Physics
PHYS 1321, Fall 2019

Instructor:	Dr. David Nero
Office:	221B Allen Hall
Office Hours:	Wednesday 12–2pm, Friday 5:30-6:30pm Other times by appointment.
Phone:	(412) 624-7394
Email:	djn23@pitt.edu

Class Website:	CourseWeb (courseweb.pitt.edu)
Textbook:	*Computational Physics* by Mark Newman

Course Description

This course covers the most commonly used computational techniques used in physics and astronomy. We will use the Python programming language in this course. No prior programming experience is required, however additional self-study is strongly recommended in that case.

Topics covered include graphing, numerical integration, curve-fitting, the solution of linear and nonlinear equations, Fourier transforms, ordinary differential equations, partial differential equations, and Monte Carlo methods.

This class is held in a "flipped" format. The lectures will be in the form of videos with short follow-up assignments. Class time will be dedicated to programming. In effect, much of the material that would have been homework in a traditional class is instead done as in-class assignments, while the passive lecture portion is completed at home, hence the name "flipped."

Course Learning Objectives

- Translate a written problem statement into executable computer code
- Demonstrate knowledge of the most commonly used computer algorithms used to solve physics problems
- Employ good programming practice while writing and debugging code
- Understand the limitations of finite precision calculations, and how to work around those limitations
- Create visualizations of data using graphs and animations
- Explain the functionality of code that you have written to your peers, and critique code written by others

Requirements

1. **Cell phones and all other electronic devices must be silenced.** In addition, students are expected to refrain from excessive electronic communication during class. Watching videos, playing games, and/or browsing the Internet is not appropriate during class.

2. **Be courteous to your neighbors.** Carrying on a conversation, habitually coming in late or leaving early, or misusing technology (as detailed above), are all disruptive to the class. Students who fail to show common courtesy will be asked to leave the classroom.

Policies

Late Assignments: Late assignments will be accepted at a penalty of 20% per day. This penalty will be waived in cases of documented emergency.

Academic Integrity: All students are expected to adhere to the standards of academic integrity. Any student engaged in cheating, plagiarism, or other acts of academic dishonesty will be subject to disciplinary action. Any student suspected of violating this obligation for any reason during the semester will be subject to the process outlined in the University Guidelines on Academic Integrity (http://www.cfo.pitt.edu/policies/policy/02/02-03-02.html).

To be completely clear, it is reasonable (and encouraged) to search online and/or work with your classmates to **develop ideas** for approaching each assignment. However, you should never **copy code** from another source. Put another way, each assignment you submit for credit must show that **you** understand how to solve the problem. In group assignments, these standards apply to the group as a whole.

Disability Services: If you have a disability that requires special testing accommodations or other classroom modifications, you need to notify both the instructor and Disability Resources and Services no later than the second week of the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. To notify Disability Resources and Services, call (412) 648-7890 (Voice or TTD) to schedule an appointment. The Disability Resources and Services office is located in 140 William Pitt Union on the Oakland campus.

Statement on Classroom Recording: To ensure the free and open discussion of ideas, students may not record classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student's own private use.

Title IX:

> "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance."

As a professor I am a mandatory reporter, and I am required to report violations of Title IX that I observe or am made aware of to the Title IX office (https://www.titleix.pitt.edu/). Title IX violations include, but are not limited to, sexual harassment, sexual violence and verbal or sexual abuse. Within the classroom, behavior in violation might appear as: suggestive jokes or innuendos, inappropriate touching, and unwanted sexual behavior or advances, but **my capacity and obligation to report does not end at the classroom**.

Grade Scale

I do not anticipate the need to curve grades. If I do curve, it will be up, never down. If you achieve the following final grade percentages in the course, you will receive at least:

Percentage	Minimum Grade
90%	A-
80%	B-
70%	C-
60%	D-

Regardless of the scale, only the top student(s) will have the potential to earn an A+. At the other extreme, no score below 50% will pass.

Grading

		%	Points
22	Video Lectures (lowest 2 dropped)	10	100 (5 points ea.)
22	In-class Assignments (lowest 2 dropped)	20	200 (10 points ea.)
11	Checkpoint Assignments (lowest 1 dropped)	20	200 (20 points ea.)
	Midterm Group Project	10	100
	Final Group Project	20	200
	Final Portfolio	20	200
	Total:	**100%**	**1000**

The course is divided into 11 week-long modules of related topics. Each module consists of two **Video Lectures** (due before class on Friday and Monday), two **In-class Assignments** (Friday and Monday in class) and one **Checkpoint Assignment** (Wednesday in class). Near the middle and end of the term, there will be **Group Projects** with time set aside for presentations. During finals week, you will submit a collection of revised Checkpoint Assignments as a **Final Portfolio** of your best work.

Video Lectures

Each lecture consists of 3–5 videos of background material and follow-up programming tasks. These are graded, but are not meant to be especially difficult. The purpose of these tasks is to hold you accountable for watching the videos. Skipping the video lectures is like skipping class. Completed video lectures are due before class.

In-class Assignments

In class, you will work to complete a programming problem. These would be homework problems if this were a traditional course. Instead, you have the benefit of being able to ask both me and your classmates for help as you work. In some ways, this setup is a like a lab. You have a task to complete and a certain amount of time to complete it. Completed in-class assignments are due at the end of class.

Substantial partial credit is available for these assignments, but to be eligible, **code must be commented**. For any non-trivial step in your program, you should have a comment explaining what you intend for the program to do.

Checkpoint Assignments

At the end of each module, there will be a class period dedicated to solving a harder programming challenge. You probably won't completely finish during class—but you should make decent progress! These are due by the end of the week. As described below, you are expected to correct any errors in these checkpoints to construct your final portfolio. These and the video lectures are your primary homework for the course. Partial credit is available for commented code.

Group Projects

In place of exams, you will complete and present a pair of group projects.

No later than two weeks before each project is due, you should form a group of 3 or 4 and meet with me at office hours at least once to discuss what you'd like to do for your project. Projects should be chosen so that each group member is able to make a meaningful contribution to the overall project. Details regarding the scope of the project and grading breakdown will be posted on CourseWeb. In brief, you will be expected to create working code, make a brief presentation to your classmates, and write a description of the project.

Your description should be detailed enough that one of your classmates could, in principle, follow it to create a working version of your project without seeing your code. I expect everyone in the group to submit the same code for their project, but the description should be written individually. It is important that everyone in the group fully understands how the overall project works.

Final Portfolio

During finals week, you will submit a final portfolio of all ten checkpoints from the semester. Unless these assignments were already perfect, you should revise them so that they reflect your very best work. As this is the culmination of your work, grading will be at a higher standard than earlier in the semester. I suggest updating your Checkpoints as soon as you receive my feedback to minimize the amount of work you need to do at the end of the term.

Bug Bounty (Extra Credit)

This course has undergone a major restructuring for this semester, so there will inevitable be a few rough spots. I will award 2–5 points of extra credit to the **first** student who finds a bug or oversight that leads to correct code failing a test. Email me when that happens, and I'll post a corrected version as soon as I can. The more severe the bug, the more extra credit it's worth. Pointing out obvious typos (like "the the") is also very much appreciated, but not worth extra credit.