Computational Methods in Physics
PHYS 1321, Fall 2022

Instructor:	Dr. David Nero
Office:	221B Allen Hall
Office Hours:	Wednesday 12:30pm–2pm, Friday 11am–12:30pm Other times by appointment.
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Class Website:	Canvas (canvas.pitt.edu)
Textbook:	*Computational Physics* by Mark Newman

Course Description

This course covers the most commonly used computational techniques 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 algorithms for solving 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 while I'm talking, 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.

3. **Heath regulations.** For the most up-to-date information and guidance, please visit coronavirus.pitt.edu and check Canvas and your Pitt email for updates before each class. If you are required to isolate or quarantine, become sick, or are unable to come to class, contact me as soon as possible to discuss arrangements.

Policies

Attendance: You will get the most out of this class if you actively participate. I realize that some absences are unavoidable, so I will drop a week's worth of assignments (see Grading section), no questions asked. Otherwise, you are expected to be in class.

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 of Pittsburgh's Policy on Academic Integrity.

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 for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS), 140 William Pitt Union, (412) 648- 7890, drsrecep@pitt.edu, (412) 228-5347 for P3 ASL users, as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

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. 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 few students will have the potential to earn an A+.

Grading

Assignment	%	Notes
Video Lectures	10	lowest 2 dropped
In-class Assignments	20	lowest 2 dropped
Checkpoint Assignments	20	lowest 1 dropped
Final Group Project	30	
Final Portfolio	20	
Total:	**100%**	

The course is divided into 11 week-long modules of related topics. Each module consists of two **Video Lectures** (due before class), two **In-class Assignments** (completed in class) and one **Checkpoint Assignment** (started in class and completed at home). At the end of the term, there will be a **Final Group Project** with time set aside for presentations. In place of a final exam, 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 immediately apply the lessons from the videos. Completed video lectures are due before class, and will not be accepted late.

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 like a lab. You have a task to complete and a certain amount of time to complete it. In-class assignments are intend to be completed during class, but the deadline is set to 11:59pm to provide some breathing room. After 11:59pm, these assignments will be accepted late at a penalty of 20% per day.

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 code 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. These are due one week later to give you ample time to ask for help when you need it. As described below, you are expected to correct any errors in these checkpoints to construct your final portfolio. To that end, the grading for checkpoints is somewhat stricter

than for the in-class assignments. Like the in-class assignments, late checkpoints will be accepted at a 20% per day penalty, and partial credit is available for commented code.

Final Group Project

Before Thanksgiving break, you will divide into groups of 3–4 and choose what you'd like to do for your project. The week after Thanksgiving will be set aside for you to work on your project in class (although you will surely need to also meet outside of class), and the following week (the last week of classes) will be reserved for presentations. 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 Canvas. In brief, you will need to:

- Submit a proposal outlining what your project will entail, and listing the tasks each group member will be responsible for.
- Present your work during the last week of classes, and collect feedback from your classmates.
- Submit a brief write-up detailing how your code works, and how each group member contributed.

Final Portfolio

During finals week, you will submit a final portfolio of all checkpoints from the semester. Unless these assignments were already perfect, you should revise them so that they reflect your very best work. 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)

Like any mortal, I make mistakes when writing code. I will award extra credit to any student who finds a bug or oversight that leads to correct code failing a test because of a mistake on my part. 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, up to 25% of the assignment's value. Pointing out obvious typos like "the the" is also very much appreciated, but not worth extra credit.