

Computational Methods - PHYS 220

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Office: LSF L103H, (843) 661-1445

Class Meeting Time: TTH 8:30 - 9:45 AM LSF L106

Office Hours: M/T/TH/F 11 - 12, 2 - 3, or by appointment.

Textbook (required)

Computational Physics, Mark Newman, ISBN: 9781480145511 (available in paperback)

Rule 0.

No one is born knowing how to code or do physics. If you are struggling, please speak with me (and/or accept my help when offered). If you are concerned that you “don’t have what it takes,” please speak with me so that I can tell you that ***that is not a real thing***.

Learning Goals

By the end of this course, the student will

- Gain an appreciation for coding in general and Python in particular
- Be able to use Python to perform common numerical analysis techniques
- Be comfortable with using Jupyter notebooks to write and present code
- Gain intuition into the concepts learned in the introductory physics series through computational exploration

Tentative Timeline (subject to change)

Week 1 - Basics of Programming: From Excel to Python

Week 2 - Advanced Basics and Control Structures

Week 3 - **Quiz 1**, Visualization of Data

Week 4 - Reading Data from Files

Week 5 - Modeling and Analyzing Data

Week 6 - **Quiz 2**, Monte Carlo Simulation (Randomness)

Week 7 - Solving the Equations of Motion I: Euler-Cromer

Week 8 - Solving the Equations of Motion II: RK4 and ODEINT

Week 9 - **Quiz 3**, Numerical Derivatives: Finite Differences

Week 10 - Numerical Integration: Trapezoid Rule and QUAD

Week 11 - **Quiz 4**, Solving Systems of Linear Equations

Week 12 - Python as Mathematica: Sympy

Week 13 - Numerical Interpolation

Week 14 - **Quiz 5**, Least Squares Fitting from Scratch

Week 15 - Final Projects

Evaluation

The final grade will be broken down in the following way

- Participation: 10%
- Homework Projects: 45%
- In-Class Quizzes: 20%
- Final Project: 25%

Attendance of all class sessions (whether in-person) is expected and will be factored into Participation, as will the completion of the in-class exercises. In accordance with University Policy, students must wear a proper face covering throughout the class.

That said, **do not come to class if you are sick**. If you are ill (COVID or otherwise) or quarantining I will work with you to help you keep up with the course and make up work as needed. In order to do this I need to know ASAP (after deadlines have passed does not qualify as ASAP). Please be aware that you are not obligated to inform me of a positive COVID-19 test or diagnosis, but if you do so I am expected to pass that information along to the University (which you should do anyway). The Final Project will be discussed later in the semester.

Format for project reports

Projects will generally be assigned weekly. **All projects must be submitted to Blackboard by 11:59 PM on the due date (i.e. before midnight)**. Requests for extensions must be submitted well in advance of the due date and will only be honored in special cases. **Any assignment submitted late will be subject to a 4 point penalty.**

Students will be required to submit evidence of some progress toward completion of the project prior to the due date, as specified on the Assignment. The finished report will contain the following components (all contained within a single Jupyter notebook).

- Progress (submitted separately as described above) (**4 pts**)
- Fully commented code (including units), together with a brief discussion of the results. If the code does not produce the correct output, please include a thorough explanation of what you were trying to do. (**14 pts, significant partial credit for documented efforts**)
- A discussion evaluating your experience working on the project. What went wrong? What went right? Were you able to stick to your timeline? Were some parts especially fun or too difficult? How would you approach the project differently? (**2 pts**)

Academic Integrity

Discussion of the projects (both with me and with other students in this course) is **allowed and encouraged**. Each student must submit a unique report that is the sole product of that student's brain, keyboard, etc. (all cheating or plagiarism will be reported and handled as detailed in the Student Handbook). I will not discriminate against any student for any reason and will make any reasonable accommodations necessary to meet a student's needs upon request. No discriminatory or hostile behavior toward fellow students will be tolerated. If you experience or witness discriminatory, abusive, or other unwanted behavior, you should contact me, the Title IX Coordinator, or other appropriate authorities.