Computational Methods - PHYS 220

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TTH 8:30 - 9:45 AM LSF L106
Office Hours: M 11:00 AM - 12:00 PM, WF 2:00 - 3:00 PM (or by appointment)
Textbook: *A student's guide to python for physical modeling, Updated Edition*, Jesse M. Kinder & Philip Nelson, ISBN: 9780691180571 (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 the usefulness and power of 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

Topics Covered (subject to change)

Coding basics (variables, assignment, arithmetic)
More complicated structures and Python specialties (loops, conditionals, lists, arrays, modules)
Visualization (plotting, interactive plots)
Solving ordinary differential equations (Euler-(Cromer/Aspel), Runge Kutta, scipy)
Reading data from files
Modeling and analyzing datasets
Using randomness (Monte Carlo integration, simulation of random events)
Numerical derivatives and integrals
Solving systems of linear equations (numpy)

Evaluation

The final grade will be broken down in the following way
- In-class Participation: 15%+
- Homework Projects: 50%
- Final Project: 35%

Attendance of all class sessions is expected and will be factored into the (substantial) participation portion of the grade. Absences need not be documented, **but all students are responsible for all material covered and all assignments regardless of attendance.** Medical or other legitimate documented emergencies will be handled on a case-by-case basis, and I will do my best to work with you to make up missed material.

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 2 point penalty.**

Students will submit a plan for completion of the project including both a rough timeline of when the components of the project will be begun (over a multi-day period!!!) and a code outline. The student is heartily encouraged to take this part of the assignment seriously.

The finished report will contain the following components (all contained within a single Jupyter notebook).
- Outline (submitted separately as described above) (**2 pts**)
- A series of notebook cells containing the fully commented code, 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. Please do not submit code that will freeze my computer. (**6 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) is ***allowed and encouraged***. Each student must submit a separate report that is the sole product of that student's brain, keyboard, etc. (in other words, all cheating or plagiarism will be reported and handled as detailed in the Student Handbook). For my part, I will not discriminate against any student for any reason and will make any reasonable accommodations necessary to meet a student's needs. 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, and/or campus police, as appropriate.