Advanced Computational Physics - PHYS 406

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Office: LSF L103H, (843) 661-1445
Class Meeting Time: MWF 8:30 - 9:20 AM LSF L106
Office Hours: M/T/TH/F 11 - 12, 2 - 3, or by appointment.

Required Text.

A Survey of Computational Physics, Robin Landau, Manuel Paez, and Cristian Bordeanu. Free ebook.
A variety of free software will be used throughout the course and will be discussed in class

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
- Be able to apply methods of computational physics to a variety of physical systems
- Be able to interpret and present the results of a calculation
- Be comfortable using an HPC cluster to execute parallel code

Tentative Schedule (subject to change)

Week 1 - Simple Harmonic Motion
Week 2 - Damped Driven Oscillators
Week 3 - Coupled Oscillators
Week 4 - Matrix Operations
Week 5 - Least Squares Fitting From Scratch
Week 6 - Coupled Oscillators and Normal Modes
Week 7 - Schrödinger Equation
Week 8 - Introduction to High Performance Computing
Week 9 - Crash Course in C++ I
Week 12 - Crash Course in C++ II
Week 11 - Diffusion Equation
Week 12 - Diffusion Equation with GPU Acceleration
Week 13 - Introduction to Computational Fluid Dynamics

Attendance

Attendance of all sessions is expected and will be factored into Participation, but **do not come to class if you are sick** (COVID or otherwise). Absences need not be documented, **but all students are responsible for all material covered and all assignments regardless of attendance.** 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).

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. **Any assignment submitted late will be subject to a 4 point penalty.**
Students will submit evidence of progress toward completion of the assignment prior to the due date (as detailed in the Assignment itself). The finished report will be graded as follows
  ● Evidence of Effort and Progress (**4 pts**)
  ● Fully commented code. If the code does not produce the correct output, include a thorough explanation of what you were trying to do. (**10 pts**, *significant partial credit available*)
  ● A brief introduction to the problem and methods, a thorough discussion of all results, and an evaluation of 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?) (**6 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 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.