SFSU Physics 440/740: Computational Physics

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Lectures & Office Hours

Lectures: MWF 10:10–11:00 in Thornton 428.
Office Hours: MF 11:10–13:00 in Thornton 308.

Quick note on e-mail contact

So that I can identify and respond to e-mails from you expeditiously, please put [PHYS440] or [PHYS740] at the beginning of the subject line. Your emails should have a salutation/greeting, a body written in standard English with correct spelling & grammar, and a closing/signature. I will respond to emails within 48 hours.

Course Overview

This course is an introduction to computational algorithms to solve realistic problems in many branches of classical and modern physics, with an emphasis on methods that are directly relevant to current research. In the lecture component, the instructor will develop the theoretical basis for various algorithms and highlight applications to relevant physics problems. In the laboratory component, students will implement the algorithms and investigate applications. Topics may include: numerical differentiation & integration; parameter fitting to experimental data; coupled ordinary differential equations for initial value problems; Fast Fourier Transforms (FFTs); finite-difference and spectral methods for partial differential equations (diffusion and wave equations); Monte Carlo techniques for statistical physics.

Course Objectives

(1) To be able to analyze real-world systems in physics, and to make valid approximations and develop simplified models of such systems;
(2) To be able to translate models of physics phenomena into the language of mathematics;
(3) To be able to identify and implement the appropriate computational algorithms to solve the mathematical representations of models of physics phenomena;
(4) To be able to understand the limitations of any physics model, its mathematical representation, or its computational solution;
(5) To be able to communicate the results of computational investigations with both written expositions and appropriate visualizations.

Required Learning Resources

(2) Access to a computer, either your own personal desktop or laptop, or an account on a department computer in Thornton 123
(3) Computational software such as MATLAB, Mathematica, IDL, or Octave; compilers for FORTRAN90, C, C++, or Python
(4) LaTeX document preparation software package

Important Websites

(1) www.physics.sfsu.edu – Department of Physics & Astronomy
(2) ilearn.sfsu.edu (note: no www in web address) – Login to access course website. Please check frequently for new announcements, updates to the syllabus & schedule, tips & tricks on assignments, and links to additional learning resources.
Prerequisites & Corequisites

(1) Math 245 (Elementary Differential Equations & Linear Algebra), or for a more rigorous treatment, both Math 325 (Linear Algebra) & Math 376 (Ordinary Differential Equations I).
(2) Physics 320 (Modern Physics I), Physics 330 (Analytic Mechanics), Physics 360 (Electromagnetism I) and Physics 385 (Intro. to Theoretical Physics)
(4) Computer Science 206, 210 or 309 or Engineering 213 or an equivalent class in basic programming in FORTRAN, C, C++, Python, etc.

Please see me if you have any concerns about your preparation.

Assignments & Grades

During the computer lab sessions, students will work on short, guided exercises to acquaint them with the computational algorithms discussed in lecture. These guided exercises will lead into more complex computational investigations that will be finished outside of class lab time. Students will be expected to produce written reports summarizing their computational investigations of various physics phenomena. Graduate students enrolled in Physics 740 will be expected to have more detailed, sophisticated investigations. This course will have no in-class or final exams. Grades will be based on the quality of the written reports.

Policy on Collaboration & Academic Integrity

You are strongly encouraged to discuss course material with your fellow classmates. When working on assignments, first try to solve the problems on your own. Struggle. Struggle some more. If you get stuck, feel free to discuss overall methods and approaches with your classmates, but not the details! Your written solutions should be solely your own, and should be written-up in isolation from your fellow classmates. Copying is strictly prohibited. Cheating via any method on assignments will result in a grade of zero on that assignment and being reported to the department chair and/or college dean for possible discipline. Please see the official plagiarism and academic ethics policies for the Department of Physics & Astronomy at: www.physics.sfsu.edu/Academics/Policy.html.

Drop, Withdrawal & Repeat Policy

The “Drop” deadline is Monday, September 10. You can drop yourself from the class online without any penalty and without any record, for any reason. After September 10, students must petition for an official “withdrawal.” Documents must be provided to support the petition to withdraw. If the petition is approved, the designation “W” will appear on the transcript. Students are only allowed to repeat a class once at SFSU. Note that designations of W, WU, NC count toward this limit.

Expected Code of Conduct

Classroom discussion and participation are strongly encouraged. However, please refrain from unrelated chatter. Also, please remember to place cell phones and other electronic communication devices on silent or vibration mode so as not to distract your fellow classmates. If you must arrive late or leave early, please sit toward the back of the room near the doors so as to minimize disruption.

Disability Access

Students with disabilities who need reasonable accommodations are encouraged to contact me early in the semester. The Disability Programs and Resource Center is available to facilitate the reasonable accommodations process. The DPRC, located in Student Services Building 110, can be reached by phone at 415-338-2472 (voice/TTY) or by e-mail at dprc@sfsu.edu.

Religious Holidays

The faculty of San Francisco State University shall accommodate students wishing to observe religious holidays when such observances require students to be absent from class activities. It is the responsibility of the student to inform the instructor, in writing, about such holidays during the first two weeks of the class each semester. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed.