PHY380: Introduction to Computational Physics

Spring 2008

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Time and Location: MF 11:10-13:00 Rauch 50
Course website http://athena.physics.lehigh.edu/

Aim

The course will provide an introduction to computational modeling as an important tool in the study of physical, chemical and biological processes.

Course Format

The course will be taught in a computer classroom, with each student having access to a computer. We will have two 2-hour sessions per week (Monday and Friday). Each week of the course will focus on a particular theme from a chapter of the textbook. The core ideas of each theme will be covered on a Monday lecture. On Friday's class we will expand on Monday's theme, based on the assigned homework; students will be asked to present their homework results and thus stimulate discussion in class.

Textbook

Required: H. Gould, J. Tobochnik, and W. Christian, "Computer Simulation Methods, Applications to Physical Systems" third edition, Pearson, 2007 (http://sip.clarku.edu/).

Recommended: W. Christian, "Open Source Physics," Pearson, 2007

See the list at the end of Chapter 1 of the textbook for a list of other books on computational physics.

Java

The course will be based on Java (http://java.sun.com/), the Open Source Physics project (http://www.opensourcephysics.org) and the Eclipse programing environment (http://www.eclipse.org/). Prior knowledge of Java is not required.

Recommended books: H. S. Schildt, "Java, A Beginner's Guide," McGraw-Hill, 2007, and "Java, The Complete Reference," McGraw-Hill, 2007.
Online Java book: Bruce Eckel, "Thinking in Java," http://www.mindview.net/Books/TIJ/
Online Java tutorial: http://java.sun.com/docs/books/tutorial/
A list of books on the Java language is available at the end of Chapter 1 of the textbook.

Course Outline

Week 1. Introduction to Open Source Physics and Java. Chapters 1 and 2.
Week 2. Simulating Particle Motion. Chapter 3.
Week 3. Oscillatory Systems. Chapter 4.
Week 4. Few-Body Problems: The Motion of the Planets. Chapter 5.
Week 5. The Chaotic Motion of Dynamical Systems. Chapter 6.
Week 6. Random Walks and Chemical Reactions. Chapter 7.
Week 7. Molecular Dynamics Simulations of Many Particle Systems. Chapter 8.
Week 8. Normal Modes and Waves. Chapter 9.
Week 9. Electrodynamics. Chapter 10.
Weeks 10 and 11. Monte Carlo Simulation of Thermal Systems. Chapter 15.
Weeks 12 and 13. Quantum Systems. Chapter 16.
Week 14. Fractals. Self-organized Critical Phenomena. Neural Networks. Chapters 12-14.

Grading

Upon satisfactory attendance, the course grade will be based on:
1. Homework. (35%). Homework and reading assignments will be assigned on Fridays. Web submission of homework is due on Thursdays. No late homework submissions will be accepted.
3. Computational course project (65%). The topic of the project will be close to each student's interests and will be decided after discussion with the instructor. The best reports will be posted on the web page of the course.

Office Hours

MW 5:00-6:00

Accommodations for Students with Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center C212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.