PHYS 4601/6601
Introduction to Computational Physics

Instructor: Prof. D. P. Landau dlandau@uga.edu

Course objectives:
Students will be introduced to numerical methods and computer programming as related to computational science with an emphasis on the solution of problems of interest to physicists. Students will be expected to gain an understanding of the fundamental aspects of computational physics as well as develop substantial, practical problem-solving ability.

Class meetings: 3rd period MWF via Zoom

Text:
Computational Physics, 2nd Edition, N. J. Giordano and H. Nakanishi (Pearson Prentice Hall, 2006)

Topical outline for the course:
1. Introduction (i.e. what are the needs and goals of computational physics)
    a. Introduction to computers
2. Some essential background (statistical mechanics, thermodynamics, random number generation, statistics)
3. Planning, constructing, and testing of computer program
    a. Introduction to computer programming
4. Projectile motion, effects of gravity, drag, and spin (e.g. why does a curveball curve?)
    a. Methods of numerical integration
5. Oscillatory motion
    a. Period doubling
    b. Chaos
6. Statistical mechanics and phase transitions
    a. The Ising model
7. Monte Carlo methods
    a. Simple sampling
    b. Importance sampling
    c. Neural networks
8. Molecular dynamics methods
9. The Schroedinger equation

Projects
Students will be required to complete multiple projects based upon material presented in lectures and in the text. For each project students will have to implement an algorithm in a computer language, debug and run the code, analyze the results, and submit a report which includes the answers to questions posed in the assignment.

Grading Policy
Semester grades will be determined by the cumulative grade for the projects.