PHYS 639 - Computations in Physics

Spring 2013

Instructor: Glenn Horton-Smith

An introduction to applying computational and numerical techniques to solve problems of interest to physicists. (Note this is not a course in programming.) Topics include the application of computational analysis and solution to physical problems in both classical and quantum physics, including particle structure and motion, interaction of particles with fields, and model building for simulation of physical phenomena. A practicum is an integral part of the course.

The course is taught in two 75-minute classes a week, with class time consisting of formal instruction and computer lab in a ratio of approximately 1:2.

Text:

P.L. DeVries and J.E. Hasbun, *A First Course in Computational Physics*, Jones and Bartlett, 2011.

Pre-requisites:

PHYS 532 (Electromagnetic Fields I) or equivalent.

Programming language (each student should pick one to use):

- MATLAB® or GNU Octave, especially for students not already familiar with some other option listed below -- examples will be provided with explanation;
- Python, with scipy library, for students already familiar with Python -- examples will be provided with explanation;
- C++ with ROOT, for students already familiar with C++ and ROOT -- some brief examples will be provided without explanation.
- Another choice of language and library may be acceptable, if the student is already familiar with them and the instructor consents in advance.

Assignments:

Assignments are based on exercises from the textbook or very similar exercises developed by the instructor. Practical exercises often consist of solving some problem by adapting or “fleshing out” examples already provided. Investigative exercises generally consist of using such programs to explore the behavior of the physics and/or the computational technique.

Reading is also assigned, and is an essential part of the learning process. About 1/2 chapter will be covered per week.

Grading:

Written reports on exercises with numerical results, plots, program listings, and explanations will be graded according to correctness (90%) and readability and style (10%). Reports and programs will be submitted via K-State Online. Feedback will be via K-State Online or e-mail.

Schedule and Reading Assignments
for PHYS 639 - Computations in Physics

Spring 2013

Week	Subjects	Wednesday Reading[1]	Weekend Reading
1	Getting Started	Ch 1 and ch 2 sec 1.	Ch 2 sec 2-10
2	Functions and roots	Ch 2 sec 11-17	Ch 3 sec 1-7
3	Interpolation and derivatives	Ch 3 sec 8-9	Ch 3 sec 10-13
4	Minimization and least-squares fitting	Ch 3 sec 14-16	Ch 4 sec 1-6
5	Integration	Ch 4	
6	More integration techniques	Ch 4	Ch 5
7	Ordinary differential equations: getting started	Ch 5	Ch 5
8	Ordinary differential equations: multidimensional	Ch 5	Ch 5
9	Ordinary differential equations: linear spaces	Ch 5	Ch 6:1-6
10	Fourier analysis	Ch 6:7-11	Ch 7:1-5
11	Partial differential equations: finite difference	Ch 7:6-10	Ch 7:11-14
12	Partial differential equations: spectral methods	Ch 7:15-20	Ch 7:21-22
13	Data analysis: interpretation of fit results	(notes to be provided)	
14	Monte Carlo techniques for data interpretation	(notes to be provided)	
15	(reserved)		

1 All readings are from the textbook unless otherwise stated.