PHY308/600: Science and Computers II

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Introduction

The goal of this course is to introduce students to computing as it is used in the physics research environment. During this course students should:

1. develop an adequate working knowledge of the UNIX operating system,
2. learn the C programming language,
3. present results graphically using the graph plotting package `gnuplot`,
4. become familiar with use of the GNU Scientific Library,
5. gain experience writing scientific reports.

You will use these skills to model physical systems on a computer and use numerical analysis to solve physical problems.

Recommended textbooks

There is no required text for this class as we will be following material on handouts given out in class, however you may find the resources below helpful. There are many excellent online tutorials for learning C and UNIX, for example:

- `http://www.mhpcc.edu/training/vitecbids/UnixIntro/UnixIntro.html`
- `http://www.le.ac.uk/cc/tutorials/c/`

In addition to these, the following textbooks may be useful:

The C Programming Language, Brian W. Kernighan and Dennis M. Ritchie (Prentice Hall). Presents a complete guide to C language programming written by the developers of C. Covers all aspects of the language and the C standard library. This is available from the University bookstore.

UNIX in 24 hours, Dave Taylor (Sams Publishing). If you prefer to get a textbook, rather than use an online tutorial, this is a very good introduction to the UNIX operating system. The book covers all the basics that you will need in this course.

Numerical Recipes, William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery. This is the essential book for understanding numerical algorithms. It covers far more material than we have time for in this course. If you do not want to buy the whole book, you can download the relevant sections from the second edition at `http://www.nrbook.com/a/bookfpdf.php`

GNU Scientific Library Reference Manual. Introduces the GNU Scientific Library, describes the library functions and contains example code. It is available from `http://www.gnu.org/software/gsl/manual/html_node/`

Class Schedule

The computing cluster in Room 115, Physics Building is reserved from 2pm–3.20pm on Tuesdays and Thursdays for this class. A large portion of this class involves independent study, during which time you will be writing

your programs and reports. There will be supervised lab session in Room 115 from 2pm–3.20pm on the days listed below. If you would like additional help outside the supervised hours, please email me to set up an appointment.

Tuesday January 13	**Introduction to Project 1**
Thursday January 15	**Supervised practical session**
Tuesday January 20	Independent Study
Thursday January 22	Independent Study
Tuesday January 27	**Supervised practical session**
Thursday January 29	**Supervised practical session**
Tuesday February 3	Independent Study
Thursday February 5	Independent Study
Tuesday February 10	Independent Study
Thursday February 12	Independent Study
Friday February 13	**Project 1 deadline**
Tuesday February 17	**Lecture: Numerical Differentiation**
Thursday February 19	**Lecture: Numerical Integration**
Tuesday February 24	Independent Study
Thursday February 26	Independent Study
Tuesday March 3	**Supervised practical session**
Thursday March 5	**Supervised practical session**
Tuesday March 10	Spring Break
Thursday March 12	Sping Break
Tuesday March 17	Independent Study
Thursday March 19	Independent Study
Tuesday March 24	**Supervised practical session**
Thursday March 26	**Supervised practical session**
Friday March 27	**Project 2 deadline**
Tuesday March 31	**Lecture: Solving Linear Equations**
Thursday April 2	**Lecture: Solving Linear Equations**
Tuesday April 7	Independent Study
Thursday April 9	Independent Study
Tuesday April 14	**Supervised practical session**
Thursday April 16	**Supervised practical session**
Tuesday April 21	Independent Study
Thursday April 23	Independent Study
Thursday April 28	**Supervised practical session**
Friday May 1	**Project 3 deadline**

Assessment

This course consists of supervised practical sessions and independent study. Your grade will be based on projects that you complete during the class (there are no homework assignments or exams). During the course you will be asked to complete three projects, each of which will count 1/3 towards your grade. You are expected to write up a report describing each project and submit it (with any additional material requested) by the following deadlines:

- First Report: **4pm Friday February 13, 2009**
- Second Report: **4pm Friday March 7, 2009**
- Third Report: **4pm Friday May 1, 2009**

The deadlines are for your benefit to ensure an even workload throughout the semester. Reports should be submitted to Arlene Johnson in Room 111, Physics Building. You should obtain a receipt with the date and

time your report was submitted, as *deadlines will be strictly enforced*. Late work will not be accepted without written permission from your undergraduate advisor. Work submitted after the deadline will receive a penalty of 5% for each day late. Note that work cannot be submitted during the weekend, so you will receive a 15% penalty if you submit your report on the Monday following the deadline.

Grading

Reports will be graded out of 10 on the following scale:

10. Excellent report: all project material correctly completed with a thorough, well-written report. (You should not expect to receive a 10 unless your report is exceptional. You can get an A in the class with three nines.)

9. Very good report: all project material correctly completed. Some minor issues with the presentation of the report.

8. Good report: the majority of the project material has been completed correctly with minor issues with the results or presentation of the report.

7. Sound report: most of the project material has been correctly completed, however there may be several problems with the results or presentation of the report.

6. Poor report: the project material has been completed with significant gaps or there are substantial problems with the results or presentation of the report.

0–5. Substandard report: serious problems with the completion of project material or presentation.

Grades will be assigned based on your overall score for the three projects as follows: $\geq$ 90% A; $\geq$ 85% A-; $\geq$ 80% B+; $\geq$ 75% B; $\geq$ 70% B-; $\geq$ 65% C+; $\geq$ 60% C; $\geq$ 55% C-; $\geq$ 50% D; $<$ 50% F. Raw scores will be used to compute grades; no curve will be applied to the class.

Preparation of your report

Credit will be given for the quality of your reports. Your report should be clearly structured and, should read in a coherent manner and be grammatically correct. Project reports must be word-processed, although you may write equations in by hand, if you prefer. You should take care to label any figures and any computer printouts. Pages should be numbered. The best document preparation system for scientific reports is LaTeX, although you may use any word-processing software that you are familiar with. If you wish to use LaTeX for your reports, an introduction is available from

`http://www.ctan.org/get/info/lshort/english/lshort.pdf`

Do not devote too much time to the computing at the expense of writing the report and performing whatever analysis is required. Your report should contain:

- details of what you have done,
- any special consideration you have given to solving a problem or producing code
- the answers to any questions posed in the project handouts
- enough data to support your conclusions,
- a detailed description of how you convinced yourself that the program was functioning correctly (e.g. hand checks, comparison with analytical results, correct behavior of errors, limiting forms for which solutions are known),
- whenever relevant, a summary of what you can learn from each project.

You should include suitably labeled listings of all the computer programs that you have written, either integrated into the report or as appendices. You should pay particular attention to the following points in your programs:

- **Overall structure.** Your program should be well written with sensible use of functions, variables and arrays.
- **Clarity.** You should include comments in your programs. Use sensible names for variables. Lay out your program with indentations and blank lines to show its structure.

In particular you should *avoid* the following:

- tables of data spanning many pages—your report should summarize the results, including sufficient data to answer the specific questions posed and to substantiate the conclusions that you make.
- too many graphs all showing similar effects—try to combine your data together to present it as succinctly as possible.

Some of the programs may generate very large data files. It is not necessary (or desirable) to submit print-outs of these.

Programming Help

If your program does not work, don't spend more than 30 minutes at the computer trying to fix it. Do something else for a while and then try again. Many stubborn problems have been known to fix themselves walking home! If you are still stuck after several attempts, seek help from me.

Remember: do not leave writing your program and report to the week before it is due. Pace yourself throughout the semester to ensure that you meet the deadlines. Do not be afraid to seek help from me early if you are not making progress with a project.

Academic Integrity

In this course, students are allowed and encouraged to discuss their projects with each other, but all programs and reports must be the work of the individual student and may not be copied from another students work, the texts, or any other source, except for short quotations with proper attribution. Students who are found to be copying programs or results will receive an F for the course.

The Syracuse University Academic Integrity Policy holds students accountable for the integrity of the work they submit. Students should be familiar with the Policy and know that it is their responsibility to learn about instructor and general academic expectations with regard to proper citation of sources in written work. The policy also governs the integrity of work submitted in exams and assignments as well as the veracity of signatures on attendance sheets and other verifications of participation in class activities. Serious sanctions can result from academic dishonesty of any sort. For more information and the complete policy, see:

`http://academicintegrity.syr.edu/uploads/docs/SU%20AI%20Policies%20Procedures.pdf`

Disability Statement

Students who are in need of disability-related academic accommodations must register with the Office of Disability Services (ODS), 804 University Avenue, Room 309, 315-443-4498. Students with authorized disability-related accommodations should provide a current Accommodation Authorization Letter from ODS to the instructor and review those accommodations with the instructor. Accommodations, such as exam administration, are not provided retroactively; therefore, planning for accommodations as early as possible is necessary. For further information, see the ODS web site:

`http://disabilityservices.syr.edu/`