Computer Simulations

CAPS 498-11 Spring 2008

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Classes: TR 9:30 – 11 am RCHM009

Office Hours: TR 11 – 12, MW 10 – 11 ? and by appointment

webpage: http://www.eg.bucknell.edu/~kvollmay/caps_s2008/

Text: No required textbook, but you will need a reference book / manual for C++ programming. So either use the internet and/or a book. As book I recommend:
Jeri R. Hanly, *Essential C++ For Engineers and Scientists*, Addison-Wesley, Reading 2001.
(All other class material will be in the form of hand outs.)

Course Description: This course is about computer simulations across disciplines. During the last 30 years the computer has revolutionized the natural sciences and other disciplines such as economy and ecology. Computers have made it possible to study for example the reasons for traffic jams, stock market crashes, and the shapes of snowflakes. In these and many other examples, a simple rule governs a single element, such as a a car, an investor, or a water molecule, which then gives rise to the complex behavior of the system as a whole. The computer takes care of applying the rules to a large number of elements.

Objectives: You will learn in this class how to write and run your own C++ programs and how to analyze the resulting data. We will start with an introduction to Unix and C++. For the remainder of the course you will learn about modeling (the elements and rules) via the examples listed in the course syllabus below and a project of your own choice. In a more general sense the goal of this course is to give you an introduction to research by doing it yourself.

Course Structure: This course will be a mixture of in-class work, mini lectures, and seminars (given by you!). As preparation for class you will get daily assignments such as reading assignments with a few questions and/or small programs. You will work on class-related smaller projects which will be presented in class (see projects I – III in syllabus). Since the course will be evolving based on your input, it will be essential that you come prepared to class.

Additionally, each of you will have your own semester long project where you choose your subject, model, and literature, write your own program, and analyze the resulting data. You will present preliminary results in class. After "playing" with your program, you will present your final results in a public conference. You will be assisted with your project.

Grading: *There will be no exams and no final!* It is important that you work steadily on your project and the class preparations. Since this course is mainly in the form of in-class computer lab work and seminars, your participation is essential, and therefore **attendance mandatory**. If you must miss class (e.g. for a job interview), you *must* arrange with me *ahead of time* to make up the missed class. If this is not possible (e.g. last-minute emergencies), you must contact me immediately. Each unexcused missed class will result in 1/3 of a letter grade deduction from your final grade! Three unexcused missed classes result in an F. For any late *daily* assignment you will get **no** credit. For the projects I & II you will write two page long papers (for due dates see syllabus) and you will present your results in a 7 min long talk. On the project III you will work and present your results in class in groups of three. For the main project of your own choice you will write two papers. The first will be about the background of your subject and a precise description of the model. A complete description of your project, including model, program, data analysis and conclusions will be in your second paper. For any late paper you will get a 10% point reduction for each late calendar day (maximal reduction: 50%). We will make a pamphlet with the abstract for your final, public presentation. To maintain the right pace for your project note the deadlines given in the syllabus and marked with *.

Daily Assignments & Participation	15 %
Projects I & II:	
Papers	10 %
Talks	10 %
Project III:	5 %
Main Individual Project:	
Bibliography	5 %
Flow Diagram	5 %
First Paper	10 %
First Talk	10 %
Second Paper	10 %
Second Talk	10 %
Final Program	10 %

Course Syllabus (updated)

Date	Topic	Due Dates
Jan. 17	Introduction	
Jan. 22	Introduction to C++	
Jan. 24		
Jan. 29		
Jan. 31	Cellular Automata: Game of Life	Bibliography / Model 1st Version*
Feb. 5		
Feb. 7		Bibliography / Model Final Vs.*
Feb. 12		
Feb. 14		Project I
Feb. 19	Traffic Flow	Background*
Feb. 21		
Feb. 26		1st Paper: 1st Version*
Feb. 28		
March 4	Talks Intro	
March 6		Project II
March 18	Talks I	1st Paper: Final Version*
March 20		
March 25		Flow Diagram*

Date	Topic	Due Dates
March 27	Fractal Growth	individual meetings
April 1		individual meetings
April 3		Running Program*
April 8		
April 10	Applications (J. Tranquillo)	Results*
April 15	Project III	Abstract*
April 17	Summary / Outlook	2nd Paper: 1st Version*
April 22	Symposium: Talks II	
April 24		
April 29		2nd Paper: Final Version*