

Computer Simulations

CAPS 499-11 Spring 2009

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Classes: TR 9:30 – 11 am RCHM017

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

webpage: http://www.eg.bucknell.edu/~kvollmay/caps_s2009/

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 main 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 (mostly) in-class computer lab work, mini lectures, and seminars (given by you!). As preparation for class you will get homework 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. The first unexcused missed class will result in a full letter grade deduction from the first larger assignment, the second unexcused missed class in a 1/3 letter grade deduction from your final grade, the third unexcused class in a full letter grade deduction from your final grade, and the fourth unexcused class will result in an F. Since usually at the beginning of class I will give an introduction to the in-class lab work, you will be sent home, if you come late to class. However, there is no need for any of the above, you can reach me any time so that I can help with planning ahead of time how to make up any class that you will need to miss. For any late *homework* 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%).

Grading
(continued):

You are encouraged to work together on assignments, but the “write up of your solutions” you have to do individually. In the case of programs this means that you have to write the program yourself. For further clarification of academic responsibility please see <http://www.bucknell.edu/x1324.xml> and <http://www.bucknell.edu/Documents/Engineering/ComputerScience/student-conduct-policy.pdf>. In the case of any doubt please ask.

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 *.

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|--------------------------|------|
| Homework | 15 % |
| Projects I & II: | |
| Papers | 10 % |
| Talks | 10 % |
| Project III: | 5 % |
| Main Individual Project: | |
| Bibliography & Model | 5 % |
| Flow Diagram | 5 % |
| First Paper | 10 % |
| First Talk | 10 % |
| Second Paper | 10 % |
| Second Talk | 10 % |
| Final Program | 10 % |

Course Syllabus

| Date | Topic | Due Dates |
|----------|------------------------------------|---|
| Jan. 15 | Introduction | |
| Jan. 20 | Introduction to C++ | |
| Jan. 22 | | |
| Jan. 27 | | |
| Jan. 29 | Cellular Automata: Game of Life | Bibliography / Model 1 st Version* |
| Feb. 3 | | |
| Feb. 5 | | Bibliography / Model Final Vs.* |
| Feb. 10 | | |
| Feb. 12 | | Project I |
| Feb. 17 | Traffic Flow Talks Intro | Background* |
| Feb. 19 | | |
| Feb. 24 | | 1 st Paper: 1 st Version* |
| Feb. 26 | | |
| March 3 | | 1 st Paper: Final Version* |
| March 5 | | Project II |
| March 17 | Talks I | |
| March 19 | | Flow Diagram* |
| March 24 | | |

| Date | Topic | Due Dates |
|----------|-----------------------------------|---|
| March 26 | Fractal Growth | individual meetings |
| March 31 | | individual meetings |
| April 2 | | Running Program* |
| April 7 | | |
| April 9 | | Results* |
| April 14 | | Project III |
| April 16 | J. Tranquillo & Summary / Outlook | 2 nd Paper: 1 st Version* |
| April 21 | Symposium: Talks II | |
| April 23 | | |
| April 28 | | 2 nd Paper: Final Version* |