CPS 304 **Spring 2009** MWF 1:15 - 2:15
Modeling and Simulation Holmes 202

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Office Hours:
1:15:-3:15 MW
And by appointment

NOTE: Do not use any other email address to contact me. This is the only one I can check from anywhere.

Textbook:

* *Discrete-Event System Simulation, 4th Ed.*, Banks, Carson, Nelson, Nicol
* Supplementary materials as distributed in class.

Description:

An introduction to computer simulation methods and tools most often used in the physical sciences and other applications, and general principles of computer simulation. Because of increased computing power and advances in simulation methods, the simulation (computer experiment) has become a crucial tool in basic research, technological applications, and many other applications such as finance. To perform a simulation requires (a) initial conditions, (b) a description of how the different parts of the system interact with each other and, perhaps, the outside world, (c) conditions for how entities enter the system from the outside world or leave the system and (d) equations or principles that describe how the system evolves given these principles and conditions. If the mathematical model is close enough to reality then simulation can yield useful results.

Computer simulation is useful because the equations that govern most real systems of interest can not now (or for the foreseeable future) be solved exactly; they must be solved approximately and numerically. For example, if a planet and a sun are modeled as point masses interacting by gravity, then it can be proven that a bounded planetary orbit is either circular or ellipticalif only the planet and sun are considered. However, no one has found an exact solution for, say, the entire solar system, or even for the general 3-body problem. By using computer simulation to obtain a series of snapshots, it is possible to study the behavior of a system at a level not always directly observable (for example, in molecular simulations). In addition, computer simulation can be used to study the operation of a proposed system before it is produced; this approach has saved billions of dollars and years of development time for designing cars, planes, and other vehicles and components such as engines.

Simulations can be broadly characterized according to whether the system consists of discrete particles, continuous media, or both. One example of particle dynamics is planetary motion in the solar system, in which the planets are treated as particles that interact through gravity. Perhaps the most familiar example of continuous medium simulation is weather prediction. Other kinds of simulations contain both discrete particles and continuous media.

Simulations can also be categorized as deterministic, stochastic (random), or combined. In deterministic simulations, once the initial conditions are given, the future behavior of the system can be completely determined. One example of this is a planetary simulation: given locations and velocities at one instant, its possible to determine future locations and velocities. Stochastic simulations have random yet systematic

behavior built in. An example of this is simulations of vehicle traffic: you may know how many cars per minute travel a street, but not (beforehand) the times at which they enter the street.

This course will introduce:

1) Discrete event simulation, in which sudden changes to the system are scheduled to occur at discrete times rather than continuously. Applications include checkout lines, construction schedules, etc. This is the courses first example of stochastic simulation. Topics will include: (a) basic principles of discrete event simulation, (b) discrete and continuous probability distributions used in discrete event simulation, (c) queueing systems, and (d) the use of SIMPROCESS, a Windows-based discrete event simulation package.

2) The use of shell scripts to automate calculations and other tasks. This makes generation and analysis of results faster, less error prone, and more organized.

3) Additional applications of stochastic simulation. Topics will include: (a) general considerations for setting up stochastic simulations, (b) some basic statistical principles, and (c) applications such as models for forest burning.

4) The elements of simulation for few body planetary and astrophysical systems. Topics will include: (a) the process of formulating a question in terms of the initial conditions and quantitative principles that govern the simulation, (b) translation of the equations governing planetary motion into a form that can be solved numerically on computer, (c) design/debugging of the software and verification of its correctness, and (d) analysis of simulation data.

Grading:

Your final grade will be based on:

- 60% Homework assignments
- 40% 2 large projects (each will require a formal technical report).
- 20% Final Exam.

Your final weighted average will be determined using the weights indicated and your grade will be determined according to the following scale:

Average	Grade	Average	Grade
100-95.0	A	74.0-76.9	C
94.9-90.0	A-	70.0-73.9	C-
87.0-89.9	B+	67.0-69.9	D+
84.0-86.9	B	64.0-66.9	D
80.0-83.9	B-	60.0-63.9	D-
77.0-79.9	C+	< 60.0	E

The instructor may administer quizzes in class (announced or unannounced) at any time. These will be included with the take-home project scores. This will almost certainly be done if significant numbers of students fail to submit homework assignments on a timely basis or produce a very low quality of work.

From time to time, there will be in-class projects (10 points each, counted in the homework total). If you are absent, these cannot be made up.

Assignments:

Homework assignments given in class will have varying due dates. Short assignments will usually be due at the next class meeting while longer assignments will be due in 1-2 weeks time. These assignments

typically involve analytical investigation and computer programming. Late assignments will be penalized at a rate of 25% points per day. Homework is due at the beginning of class. No assignments of any type will be accepted after the final class meeting day. Students may meet together in small groups to discuss aspects of a given assignment, but all work presented must be your own.

As the semester proceeds, all assignments will need to be produced using document processing software as MS Word. When computer output is requested, provide printouts of the programs and other material as requested. Do not submit large volumes of printed data.

Policies

Students with Special Needs Students with documented disabilities may be entitled to specific accommodations. SUNY Brockport's Office for Students with Disabilities makes this determination. Please contact the Office for Students with Disabilities at 395-5409 or osdoffic@brockport.edu to inquire about obtaining an official letter to the course instructor detailing approved accommodations. The student is responsible for providing the course instructor with the official letter. Faculty and staff work as a team with the Office for Students with Disabilities to meet the needs of students with disabilities.

NO CELL PHONES OR PAGERS. These are distracting to other students. You will lost 1/2 credit on your next homework assignment if a cell phone or pager goes off during class.

Attendance:

You are expected to attend all classes. Significant amounts of material are not contained in the textbook. If you miss a class, it is your responsibility to get class notes and handouts and find out what you missed. The instructor reserves the right to fail any student who acquires more than 4 unexcused absences.

No incompletes or withdrawals will be given for this course except in cases of illness, personal tragedy, or extraordinary circumstances beyond the student's control, and then only if documented to the instructor's satisfaction.

Here is the official SUNY Brockport Attendance Policy:

The student is responsible for all assigned course work and cannot be absolved of this responsibility. When enrolled in a particular course, the student is obligated to do all of the work assigned. Punctual and regular attendance is vital to the discharge of this obligation. Absences, excused or not, do not alter this responsibility. Absences deemed excessive by the instructor may result in a lowered grade. Students whose unexcused absenced exceed 15% of the scheduled classes and laboratories will be subject to failure at the instructors discretion. Absences will be excused for (a) documented illness, (b) official representation of the college, (c) death of a close relative, (d) religious holiday, and (e) circumstances beyond the control of the student. Excuses for official representation of the college must be obtained from the official supervising that activity or event. Policies regarding absences from quizzes, exams, and laboratory sessions will be at the discretion of the instructor. Substantiation of excused absences is, in any case, the responsibility of the student. Regulations more restrictive than those stated above may be established by the instructor.

Authorship:

When you turn in an assignment, you are certifying it as your own work. Submitting material as you own work that is not entirely of your own authorship, or knowingly providing an answer to another person constitutes cheating. If I am convinced beyond a reasonable doubt that cheating has occurred, the person(s) submitting the illicitly obtained answer, and any person(s) knowingly providing same, will receive a grade of zero for that assignment. Further disciplinary procedures may also be considered.

Buckley Amendment:

The purpose of the Buckley Amendment is to protect the confidentiality of your grades. This law states that I cannot reveal any information regarding your performance in the course to anyone other than yourself and authorized college administrators without your written permission.

Disclaimer:

Announcements given in class are considered official addenda to this policy. All policies described are subject to change as the situation warrants. Should changes be necessary, all students will be notified in a timely fashion.