CSCI 299: Simulation and Modeling

Syllabus – Spring 2012

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Course Description

When real-world experiments are either too dangerous or too expensive to perform, computer simulation is used as an alternative. In addition to considering how to model real-world problems using computer simulation, this course studies other relevant topics including how to generate random data using a deterministic machine and how to collect and display data in a meaningful way.

Course Goals

Upon completion of this course, a successful student will be able to:

- Decide whether Monte-Carol or discrete-event simulation are appropriate for a given problem.
- Verify and validate a discrete-event model and simulation.
- Select and produce appropriate graphical representations for discrete and continuous data.
- Efficiently generate pseudo-random numbers in multiple independent streams and generate discrete and continuous random variables.

Required Texts

In addition to the following required text, supplementary readings may be given periodically during the semester.

- *Discrete-Event Simulation: A First Course* by Lawrence M. Leemis and Stephen K. Park

More than other courses, this course is driven by the text. You should expect to spend about an hour before each class session working through the readings. This means reading the text for detail and working to learn vocabulary – not just skimming through the material before class.

To further support your preparation for class, slides for each section will be available online.

Graded Material

- **Homework** - The goal of homework problems is for you to explore the topics in more detail, and the homework problems given in the book support this objective. For each section we cover, I will assign one or two of these problems. Each problem requires one to three hours of work:

  1. Re-read the text for required details.
  2. Design and implement a simulation or modify an existing simulation.
  3. Run the simulation with a variety of parameters to generate data.
  4. Generate appropriate graphical or tabular representations of the data.
  5. Interpret your results.

  You are *strongly* encouraged to collaborate with the other students in the course on these problems.

  Approximately every third class period will be used to review homework problems. Students will present their approach to the problem and their results to the class, and then we will discuss the significance of each problem in terms of the course goals.

  Following these discussions, each student will produce a write-up of their solution, due the following class session. These solutions should be written in the *other student context.* You should provide enough written explanation so that another student in the class, who did not know how to complete the exercise, could read the submitted material and, without asking questions, understand what should have been done. Written responses that consist entirely of printed source code (even if bullet proof and well documented) are incomplete and poorly written.

  Homework problems will be graded using two rubrics on a scale between zero and three.

  Correctness:

  – **3**: You solved the problem perfectly and/or generated the proper data.
  – **2**: Your solution had non-trivial errors.
  – **1**: You tried the problem, but either didn't get very far or made serious mistakes.
  – **0**: You failed to turn anything in for the problem.

  Presentation:

  – **3**: Your write-up presents your work in such a way that another student in the course could reproduce your results without asking any questions. Further, your discussion of the problem clearly articulates your conclusions.
  – **2**: Your write-up leaves open for interpretation various aspects of your approach or your conclusions are incomplete.
  – **1**: Your write-up contains serious omissions. This includes write-ups consisting solely of code snippets and/or data.
  – **0**: You failed to turn anything in for the problem.

Note that you can early a “3” on the presentation even if you earn a “1” for the correctness. This would mean that you clearly articulated your attempt to solve the problem, and where you ultimately became stuck.

At the end of the semester, the average of your correctness and presentation scores will translate into an actual letter grade as follows:

≥ 2.5	A
≥ 2	B
≥ 1.5	C
≥ 1	D
< 1	F

Essentially, this scale means that you must earn threes on at least half of the problems to be in the A range (with the remainder of your scores being twos). Plusses and minuses will be used within each range.

- **Midterm** - A take-home midterm will be distributed in-class on Friday, February 17 and is due on Friday, March 2. The midterm will contain two questions similar to homework problems and must be completed without collaboration.
- **Projects** - Students will complete two projects during the semester. The first will be based on Monte Carlo simulation, and specifications will be distributed in-class on Wednesday, February 1. Students will present their work on Monday, February 20 and Wednesday, February 22. The second project will be based on a Discrete-Event Simulation. Specifications will be distributed in-class on Friday, March 16, and presentations will occur on Wednesday, April 25 and Friday, April 27. For both projects, the final write-up will be due at the time of the presentation.
- **Final** - The take-home final exam will be distributed in class on Friday, April 20 and will be due Monday, April 30 at 11:30 a.m. The format to this exam will be similar to the midterm.

  Any change to the final exam schedule must be approved by both me and the dean of students.

Grade Determination

- Homework: 40%
- Midterm: 10%
- Project #1: 15%
- Project #2: 20%
- Final: 15%

All grades will be computed on the standard scale using plusses and minuses.

Course Policies

- **Responsibilities** – Your attendance is expected at each class meeting. You are also responsible for the contents of reading assignments, handouts, class activities, and class email.
- **Late Policy** – I understand that life sometimes gets in the way of getting work done. Consequently, late assignments will be accepted without penalty in the class after the assignment was due. However, this policy should not be used as a crutch, and if you frequently use it I will deduct from your grade. After the next class session, late work will not be accepted unless there are exceptional circumstances.
- **Extensions** – In a similar vein, I am generous with extensions on work if you approach me *before* the day the assignment is due.
- **Academic Honesty** – Except on tests, you are *encouraged* to discuss the material and work with other students in the course. This policy does not allow you to copy another student's work verbatim – you must produce your own code or write-up of the material. Work together to learn the concepts, but keep in mind that you are ultimately responsible for the material on the tests.
- **Disabilities** – If you have a disability that may affect your performance in this course, please contact me immediately to discuss academic accommodations.

Course Schedule

Date	**Reading**	**Topic**
M Jan 16	• Section 1.1	• Introduction
W Jan 18	• Section 1.2	• A Single-Server Queue
F Jan 20	• Section 1.3	• A Simple Inventory System
M Jan 23		• Sections 1.2 and 1.3 Problem Discussion
W Jan 25	• Section 2.1	• Lehmer Random-Number Generators: Introduction
F Jan 27	• Section 2.2	• Lehmer Random-Number Generators: Implementation
M Jan 30		• Sections 2.1 and 2.2 Problem Discussion
W Feb 1	• Section 2.3	• Monte Carlo Simulaion
F Feb 3	• Section 2.4	• Monte Carlo Simulation Examples
M Feb 6		• Sections 2.3 and 2.4 Problem Discussion
W Feb 8	• Section 3.1	• Discrete Event Simulation
F Feb 10	• Section 3.2	• Multiple-Stream Lehmer Random-Number Generators
M Feb 13		• Sections 3.1 and 3.2 Problem Discussion
W Feb 15	• Section 3.3	• Discrete-Event Simulation Examples
F Feb 17		• Section 3.3 Problem Discussion • Take-home Midterm Distributed

Date	Reading	Topic
M Feb 20		• Project #1 Presentations
W Feb 22		• Project #1 Presentations
F Feb 24	• Section 4.1	• Sample Statistics
M Feb 27	• Section 4.2	• Discrete-Data Histograms
W Feb 29	• Section 4.3	• Continuous-Data Histograms
F Mar 2		• No Class: SIGCSE • Midterm Due
M Mar 5 – F Mar 9		• Spring Break
M Mar 12		• Section 4.1, 4.2, and 4.3 Problem Discussion
W Mar 14	• Section 5.1	• Next-Event Simulation
F Mar 16	• Section 5.2	• Next-Event Simulation Examples
M Mar 19		• Sections 5.1 and 5.2 Problem Discussion
W Mar 21	• Section 5.3	• Event-List Management
F Mar 23	• Section 6.1	• Discrete Random Variables
M Mar 26		• Sections 5.3 and 6.1 Problem Discussion
W Mar 28	• Section 6.2	• Generating Discrete Random Variables
F Mar 30	• Section 6.3	• Discrete-Random Variable Applications
M Apr 2		• Sections 6.2 and 6.3 Problem Discussion
W Apr 4	• Section 7.1	• Continuous Random Variables
F Apr 6 – M Apr 9		• Easter Break
W Apr 11	• Section 7.2	• Generating Continuous Random Variables
F Apr 13		• Sections 7.1 and 7.2 Problem Discussion
M Apr 16	• Section 8.1	• Interval Estimation
W Apr 18	• Section 8.4	• Batch Means
F Apr 20		• Sections 8.1 and 8.4 Problem Discussion
M Apr 23		• Slip Day
W Apr 25		• Project #2 Presentations
F Apr 27		• Project #2 Presentations

The details of this syllabus and schedule are subject to change based on our progress through the material.