University of Manitoba | Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 4520 – Simulation and Modelling

Winter 2016

Course Outline

Instructor

- Prof. Miroslaw Pawlak, P.Eng.
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Office Hours
- Monday, Wednesday, Friday
  2:00PM – 4:30PM

Contact Hours
- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:
- STAT 2220 Contemporary Statistics for Engineers
- COMP 2140 Data Structures and Algorithms

Course Website:
https://ece.eng.umanitoba.ca/undergraduate/ECE4520

Important Dates

- **Term Test**
  TBD
- **Voluntary Withdrawal Deadline**
  March 18th, 2016
- **Spring Break**
  February 15th–19th, 2016
  No classes or examinations
- **Good Friday**
  March 25th, 2016
  No classes or examinations

Course Objectives

The topic of performance modeling consists of discovering and ascertaining the efficiency of computer, economics, and communication networks. It may be, for example, concerned with the estimation of the performance behavior of systems under construction, or monitoring that of an existing one. The findings of a quantitative performance study may be used to guide decisions relating to system design, the allocation of machine resources, the acquisition of additional facilities, or the tuning of an existing configuration. Carrying out proper performance analysis is recognized as an integral part of the professional construction and management of computer and communication systems, industrial systems, and economics. The systems in which we are interested are subjected to demands of random character. The processes that take place in response to those demands are therefore also random. The modeling tools that are needed to study such systems are provided by the theory of random processes and stochastic simulation techniques. The course will cover both simulation techniques (Monte Carlo Techniques, Event Driven Simulation) and analytical methods (Markov Models and Queuing Networks).

Course Content

The following topics will be covered:

- Introduction to Performance Modeling
- Essentials of Probability and Statistics
- Monte Carlo Modeling
  - Random variate generation
  - Discrete event simulation
  - Output analysis
- Random number generation
  - Traffic Processes
  - Point Processes/Regenerative Method
  - Poisson Processes
- Markov Models
  - Synchronous Processes: Discrete-time Markov Chains
  - Asynchronous Processes: Continuous-time Markov Chains
  - Case Studies:
    - Hidden Markov Models
    - Random Walk and Brownian Motion
    - Page Rank Algorithms
    - Markov Chain Monte Carlo
    - Random Search
- Introduction to Queuing Models.

Textbook

Simulation, S. Ross, Academic Press, 2006, 4th Edition.

Probability and Statistics with Reliability, Queuing and Computer Science Applications, K.Trivedi, Wiley, 2002, 2nd Edition

Requirements/Regulations

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic*

Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.

- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.

Learning Outcomes

1. Identify, distinguish and explain basic modeling components both using analytical and simulation models.
2. Analyze communication and data networks systems via stochastic modeling methods.
3. Designing event-driven models.
4. Analyze output data generated from simulation modeling.
5. Understand simulation algorithms employing Monte Carlo techniques.

Expected Competency Levels

Outcome	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
1	2	2		2		3	2					3
2	4	4		2	2	3	2					3
3	5	5	4	2	4	3	2					3
4	5	5	5	2	4	3	2					3
5	5	5	4	2	4	3	2					3

Evaluation

The final course grade will be determined from a student's performance in laboratories, periodic quizzes, 2 term tests, and a final examination. Students must complete all of the laboratories in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Quizzes	15	F, S	1, 2, 3, 4
Laboratories	15	F, S	1, 2, 3, 4
Term Tests	20	F, S	1, 2, 3, 4
Final Examination	50	S	3, 4

* Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Accreditation Details

Accreditation Units

- Mathematics: 25%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 75%
- Engineering Design: 0%

Attributes

A1: A knowledge base for engineering
A2: Problem analysis
A3: Investigation
A4: Design
A5: Use of engineering tools
A6: Individual and team work
A7: Communication skills
A8: Professionalism
A9: Impact of engineering on society/ environment
A10: Ethics and equity
A11: Economics and project management
A12: Life-long learning

Competency Levels

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

Updated: January 6, 2016