CIS*2460 Modelling of Computer Systems - DRAFT

Fall 2019
Section(s): C01

School of Computer Science
Credit Weight: 0.50
Version 1.00 - September 03, 2019

---

1 Course Details

1.1 Calendar Description

This course examines discrete simulation based on event queues and random number generation. Methods for generating input data, measuring and evaluating results using standard statistical tests are studied. Topics covered will include model calibration and validation, and algebraic, probabilistic and simple queuing models of software and hardware operation.

Pre-Requisites: CIS*2500, STAT*2040

1.2 Course Description

This course focuses on the use of computer programs to simulate (or model) the behavior of complex systems under different scenarios. While many computer simulation techniques exist, we will study stochastic simulation with a specific emphasis on discrete-event simulation. Stochastic simulation has many applications across numerous fields of study. For example, stochastic simulation is used in: design of computer systems to model data processing and flow; evaluating the design of service organizations (e.g., the number of people employed) like call centers, delivery services, peer-to-peer ride sharing services etc. A critical learning objective for students of this course is to be able to develop and program discrete-event simulation models of complex systems. Hence, the students will build such models in the R programming language.

1.3 Timetable

LECTURE: Tues, Thur 10:00AM - 11:20AM, MCKN, Room 307

LAB: Mon 07:00PM - 08:50PM, ROZH, Room 108

1.4 Final Exam

Fri 07:00PM - 09:00PM (2019/12/13), Room TBA

* Exam time and location is subject to change.

---

2 Instructional Support

2.1 Instructional Support Team

Instructor: Taimoor Akhtar
Email: akhtart@uoguelph.ca

Office Hours: Tue: 11:30 AM to 12:30 PM

Fri: 9:30 AM to 11:30 AM

Room: REY 0004

2.2 Teaching Assistants

Teaching Assistant: Jarrett Phillips
Email: jphill01@uoguelph.ca
Office Hours: During lab (Mon 7:00-9:50pm)

Room: ROZH 108

---

3 Learning Resources

3.1 Required Resources

Lecture Slides / Handouts (Notes)

Slides for a topic will be posted online on CoureLink (https://courselink.uoguelph.ca/shared/login/login.html) before the lecture(s) on this topic. Slides will contain the primary course material (unless additional mandatory readings are specified*).

*** Required Readings:** Announcements for any required readings will be made in-class and posted on courselink.

3.2 Recommended Resources

M. Templ, "Simulation for Data Science with R" (Textbook)
Provides an R-based hands-on approach to understanding data-driven stochastic simulation.

M. Law, "Simulation Modeling & Analysis" 5th ed. (Textbook)
Provides a comprehensive coverage of fundamental topics in simulation modeling.

---

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. List the difference between different simulation techniques: e.g., dynamic vs static, discrete vs continuous and deterministic vs stochastic.
2. Identify systems that behave stochastically and can be modelled via discrete-event simulation.
3. Define the core components of discrete-event simulation modelling.
4. Build discrete event simulation models using R.
5. Write pseudocode to implement a variety of stochastic algorithms.
6. Use probabilistic methods to prepare simulation inputs.
7. Assess performance of simulated systems using statistical methods
8. Understand and appreciate the art of modelling: e.g., what and what not to model, specifying assumptions, collecting data, analyzing and presenting results etc.

---

5 Teaching and Learning Activities

In-Class / Lecture Experience: Class sessions will be a blend of instruction, group activities, discussions and reflective questions. Handouts of instructional material will be posted on course-link ahead of each class. Students are encouraged to bring these and their laptops to class.

Labs and Programming in R: Students are expected to improve their programming competency in R as the course progresses. All programming assignments and projects are to

be implemented in R. Hence, the first few lab sessions will introduce the students to basic programming and data structures in R. In the remaining lab sessions students will attempt interesting simulations (e.g., based on the Law of Large Numbers) and may also work on assignments and ask questions about assignment content. Students must bring their laptops to every lab.

Mid-Course evaluation: Students will be requested to provide a mid-course evaluation (via google form). The evaluation form will i) allow the students to give feedback on the effectiveness of the course design, instructor, in-class experience, lab experience and teaching assistance on their learning (and as per learning objectives) and ii) vote for their topics of interest (from options provided) to be covered in the last quarter of the course.

Evolving Curriculum: As mentioned earlier, students will have the option of choosing some topics to be covered in the last quarter of the course.

5.1 Lecture

When	Topic	Reference
Week 1	What is simulation and what is discrete-event simulation?	Handouts
Week 2	The role of probability in model building + Probability Review.	Handouts + To be Announced (TBA)
Weeks 3-5	Input modelling: Selecting and fitting Probability Distributions	Handouts + TBA
Week 6	4 Random number generation	Handouts + TBA
Weeks 7-8	Output analysis: Statistical analysis of simulation output	Handouts + TBA
Week 9	Building simulation models	Handouts + TBA

When	Topic	Reference
Weeks 10-11	Optional Topic 1: Tentative options are a) Simulation-Optimization Methods, 2) Model Validation, 3) Monte-Carlo Methods, 4) The connection of statistical modelling with machine learning.	Handouts + TBA
Weeks 12-13	Optional Topic 2: Tentative options are a) Simulation-Optimization Methods, 2) Model Validation, 3) Monte-Carlo Methods, 4) The connection of statistical modelling with machine learning.	Handouts + TBA

6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Assignment 1	10
Assignment 2	10
Assignment 3	10
Final Project	20
Midterm	15
Final Exam	35
Total	100

6.2 Assessment Details

Assignment 1 (10%)
Learning Outcome: 1, 2, 6

Assignment 2 (10%)
Learning Outcome: 5, 7

Assignment 3 (10%)
Learning Outcome: 3, 4

Final Project (20%)
Learning Outcome: 4, 6, 7, 8

Students will apply their discrete-event simulation modeling knowledge in a final project. The project will involve development of a discrete-event-simulation for a real-world application (more details will be provided later in the course). The project may be done in teams of 2-3. Project evaluation will be based on submission of 1) a final project report (one per group) and 2) a working code of the developed simulation model. Individual contribution of group members will be assessed by their group members via peer evaluation forms.

Midterm (15%)

Final Exam (35%)

6.3 Assessment Policies

Late Submissions (Assignments): There is a 1% (of 10%) per every 6 hours late penalty up to 48 after the due date, after which the assignment will be given a grade of 0.

Late Submissions (Project): Late submissions will not be accepted and will receive a grade of 0.

Midterm Absence Policy: If a midterm is missed for a valid reason, appropriate documentation (e.g., a doctor's note) must be submitted to the course instructor within one week of the midterm exam. If accepted, the midterm weighting will be transferred to the Final exam (i.e., the Final exam will be worth 50% of the student's course grade). All other students who miss the midterm without reason will receive a grade of 0.

---

7 University Statements

7.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

7.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

7.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

7.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

7.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website

https://www.ridgetownc.com/services/accessibilityservices.cfm

7.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

7.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

7.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars