# Course Syllabus
## Simulation and Modeling (CSCI 3010U)

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http://faculty.ontariotechu.ca/qureshi

Computer Science, Faculty of Science

Ontario Tech University

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## Instructor

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## Lectures

Wednesday, 2:10-5:00, UA2130
*First day of lectures, Wednesday, January 10, 2024.*

## Labs

In case the course has multiple lab sections. Each student will be assigned to one of these lab sections. All labs cover the same material. Each lab section is limited to 24 students, and these are filled on a first-come bases.

- Section 1
  Tuesday, 12:30-2:00, UB2058
- Section 2
  Friday, 2:10-3:30, UB2058
- Section 3
  Friday, 3:40-5:00, UB2058

## Office hours

Monday, 1:00-2:00

- in-person in room UA4032
- online at https://meet.google.com/qta-qyuk-aja
- or by appointment

## Course Discussion Group

We will use Piazza for course related discussions and conversations:

- Course Piazza

## Course Description

This is a survey course on simulation methodologies, techniques, and applications.

Constructing computer simulations is perhaps one of the funnest things one can do with a computer. Imagine the thrill of simulating an entire planet inhabited with life-like beings going about their business, pondering life's big questions? Ok, we aren't quite there yet, but already we have access to countless games that simulate one phenomenon or another for the purposes of entertainment. Think SimCity that simulates a metropolis, or Factorio that simulates, what can only be described as, a logistics nightmare. We have games that simulate driving cars, flying airplanes, playing soccer, hunting big game, and fighting in wars, etc. Similarly we have games that simulate entire worlds populated with dinosaurs and robots and everything in-between: Xenoblade, any one.

Within this context, this course aims to introduce students to computer simulations. We will not be using simulation packages rather we will explore the mathematical models and programming practices that underpin systems that can be used to create computer simulations.

Entertainment and games are not the primary use of computer simulations however. Designers and engineers rely heavily on simulations when designing and implementing complex systems, e.g., airplanes, bridges, highways, drugs, nuclear reactors, etc. Simulations enable us to ask the what if question, which is especially useful when we do not

have the access to the actual system or when it is simply too dangerous to run the experiments on the actual system. E.g., how many cars before a bridge collapses? Clearly, we cannot pile cars on a bridge and wait for it to collapse! Many a times simulation is the only mechanism through which we can study a phynomenon.

Another use of simulations is in education and training sphere where it is sometimes easier, cheaper, less dangerous to use a simulation for training. Think how pilots are routinely trained on high-fidelity flight simulators.

Within this context, we will discuss the mathematics, physics, and statistics theory plus programming practices that underpin modern computer simulations. The focus is not to use existing computer simulation tools rather the course aims at developing competency needed to implement computer simulations. By necessity we will focus on setting up simulations for toy problems, such as a ball bouncing on an inclined plane, a factory floor, nuclear decay, random walks, etc.

### Tentative schedule

- Week 1 - Introduction and building simulations
- Week 2, 3 - Continuous systems, particle systems
- Week 4 - Rigid body dynamics
- Week 5 - Collision detection, **Midterm 1**
- Week 6 - Collision response
- Week 7, 8 - Random processes
- Week 9 - Monte Carlo simulations
- Week 10 - Discrete event systems, **Midterm 2**
- Week 11 - Many particle systems
- Week 12 - Verification and validation

## Course material

No single textbook covers all the material that we will discuss in this course. Still the following two books are useful for a deeper study of most of the topics that we will cover in this course.

- Harvey Gould, Jan Tobochnik, and Wolfgang Christian, "An Introduction to Computer Simulation Methods: Applications to Physical Systems," Third Edition, Addison Wesley, 2007.
- Wolfgang Christian, "Open Source Physics: A User's Guide with Examples," Addison Wesley, 2007.

*Students are strongly encouraged to take their own notes during lectures.*

## Grading

- Class participation, quizzes, and exercises 10%
- Lab and assignment participation and completion 20%
- Midterm exams 50%
- Course project 20%

*A student must get 50% in the midterm exams to pass the course.*

## Important dates

- Midterm 1, Wednesday, February 7, in class
- Study break during the week of February 19
- Midterm 2, Wednesday, March 20, in class
- Project selection due by March 4
  *You may loose up to 10% of the course project grade if project selection isn't finalized by Mar 4. You may loose up to an additional 20% of the course project grade if the project selection isn't finalized by Mar 11. If the project isn't selected by Mar 11, you'll be asked to provide a written explanation for the delay.*
- Project topics presentations on March 6

- Project report due on April 5, 11:59 pm
  *You may be asked to record a 3 minute long project presenation that will be submitted before the last week of lectures.*

Ontario Tech University's academic calendar that lists important dates (and deadlines) is available at here.

# Course project

The course project is an independent exploration of a specific problem within the context of this course. The topic of the project will be decided in consultation with the instructor.

Project grade will depend on the ideas, how well you present them in the report, how well you position your work in the related literature, how thorough are your experiments and how thoughtful are your conclusions.

**Teams of up to two students are allowed.**

Please use the VCLab Course Project Template available at Overleaf for your project report. It is expected that the project report is between 4 to 8 pages long.

Additionally, you may submit a 3 minutes video for your project.

Below, you will find a list of projects that students have done in the previous iterations of this course:

- Angry birds;
- Flappy birds;
- Balancing an inverted pendulum on a moving platform;
- Billiard;
- Rocket simulation;
- Stock market simulation;
- High-performance collision detection;
- Simulating a waving flag;
- The attack of zombies;
- Rigibu puzzle;
- Modeling storms;
- Fireworks;
- An analysis of customer service in call centres;
- Crowd simulation;
- A vehicle rental network;
- Golf;
- A leaf blowing in the wind; and
- Simulating waves.

# Course policies

## Class Participation and Inclass Exercises

Student participation in lectures and laboratories is strongly recommended. It is often difficult to assign a class participation mark. At the same time; however, I feel that it is important to reward students who make lectures lively and interesting for everyone. In order to assign class participation marks, I will provide in-class exercises and quizzes during during each lecture. Theses exercises will require programming and will cover the topic currently under discussion. These exercises are due before the end of the lecture. When grading these exercises, I will focus more on the attempt rather then the correct solution. Paying attention during lectures and taking your own notes is one way to successfully complete these exercises.

## Course Work Submission

Unless otherwise instructed, all course work should be submitted using course Canvas.

### Partial marks

Assignments will primarily be evaluated based on the correctness of solutions; however, partial credit may be assigned for documentation, discussion, etc.

### Remarking

It is extremely important that all work is fairly graded. Please submit a remark request by email within 5 days of receiving the grade. The email must contain the reasons for which you think the work should be remarked. *Please note that a remark may result in a lower grade.*

### Late submissions

The penalty for a late submission is 10% per day. A lab, an assignment, or a project will get a **zero** if submitted more than 48 hours after the submission deadline.

### Email traffic

The instructor and the TA will make every effort to respond to emails in a timely manner; however, it may take up to two working days to respond to an email. It simply means that emails sent right before a deadline may not be answered in time. Urgent emails may be sent to "faisal.qureshi@ontariotechu.net" with the subject line "csci 3010u - winter 2024".

### Discussions

Appropriate use of discussion groups include clarification of lecture material and assignments and other concerns and comments about the course that might of general interest to course participants. Please do not post assignment solutions to the discussion groups.

### Collaboration

I encourage you to work together when discussing assignments/projects; however, it doesn't mean that you should share your written solutions or that you submit someone else's work as your own.

## Technology Requirements

To support online learning, the university recommends certain technology requirements for laptops, software and internet connectivity which are available at: https://itsc.ontariotechu.ca/remote-learning.php.

Students experiencing technical difficulties such that they are unable to meet the technology requirements may contact the IT Service Help Desk at: servicedesk@dc-uoit.ca Students experiencing financial difficulties such that they are unable to meet the technology requirements may contact Student Awards and Financial Aid Office at: connect@ontariotehu.ca

By remaining enrolled in this course, you acknowledge that you have read, understand and agree to observe the Recommended Technology Requirements for accessing university online learning resources, including those minimum requirements that are specific to your faculty and program.

## Sensitive/Offensive Subject Matter

The classroom (both physical and virtual) is intended to provide a safe, open space for the critical and civil exchange of ideas and opinions. Some articles, media and other course materials may contain sensitive content that is offensive and/or disturbing. For example, some articles or videos may contain [Instructors should provide examples that are applicable to the course subject matter – e.g. graphical depictions of violence, profanity, human anatomy, sexual acts, matters pertaining to race, gender, or sexuality]. The Course Instructor will try to identify such material and communicate warnings to students in advance of the distribution and use of such materials, affording students the choice to either emotionally prepare for, or not to view or interact with, the content. [Instructors should publish a warning statement in advance so as to give students adequate opportunity to make a choice to avoid any such

matter. The following is a sample disclaimer: "The content you are about to view contains sensitive subject matter that may be considered offensive and/or disturbing to some viewers. By viewing and/or interacting with the content you acknowledge and agree that it is your decision to view and interact with the content and to take the risk that you will experience a negative emotional response or reaction to the nature of the content."]

## Student Support

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact studentlife@ontariotechu.ca for support. Furthermore, please notify your professor if you are comfortable in doing so. This will enable them to provide any resources and help that they can.

## Sexual Violence Support and Education

Ontario Tech is committed to the prevention of sexual violence in all is forms. For any student who has experienced Sexual Violence, Ontario Tech can help. We will make accommodations to cater to the diverse backgrounds, cultures, and identities of students when dealing with individual cases.

If you think you have been subjected to or witnessed sexual violence: - Reach out to a Support Worker, a specially trained individual authorized to receive confidential disclosures about incidents of sexual violence. Support Workers can offer help and resolution options which can include safety plans, accommodations, mental health support, and more. To make an appointment with a Support Worker, call 905.721.3392 or email studentlife@ontariotechu.ca - Learn more about your options at: https://studentlife.ontariotechu.ca/sexualviolence/

## Students with Disabilities

Accommodating students with disabilities at Ontario Tech is a responsibility shared among various partners: the students themselves, SAS staff and faculty members. To ensure that disability-related concerns are properly addressed during this course, students with documented disabilities and who may require assistance to participate in this class are encouraged to speak with me as soon as possible. Students who suspect they have a disability that may affect their participation in this course are advised to go to Student Accessibility Services (SAS) as soon as possible. Maintaining communication and working collaboratively with SAS and faculty members will ensure you have the greatest chance of academic success.

When on campus access is allowed, students taking courses on north Oshawa campus can visit Student Accessibility Services in the Student Life Building, U5, East HUB (located in the Founders North parking lot). Students taking courses on the downtown Oshawa campus can visit Student Accessibility Services in the 61 Charles St. Building, 2nd Floor, Room DTA 225 in the Student Life Suite.

Disability-related and accommodation support is available for students with mental health, physical, mobility, sensory, medical, cognitive, or learning challenges. Office hours are 8:30am-4:30pm, Monday to Friday, closed Wednesday's 8:30am – 10:00am. For more information on services provided, you can visit the SAS website at https://studentlife.ontariotechu.ca/services/accessibility/index.php. Students may contact Student Accessibility Services by calling 905-721-3266, or email studentaccessibility@ontariotechu.ca.

When on campus access is allowed, students who require the use of the Test Centre to write tests, midterms, or quizzes MUST register online using the SAS test/exam sign-up module, found here https://disabilityservices.ontariotechu.ca/uoitclockwork/custom/misc/home.aspx. Students must sign up for tests, midterms, or quizzes AT LEAST seven (7) days before the date of the test.

Students must register for final exams by the registration deadline, which is typically two (2) weeks prior to the start of the final examination period. SAS will notify students of the registration deadline date.

## Professional Conduct (if applicable)

Additional information on professional suitability can be found at https://calendar.ontariotechu.ca/content.php?catoid=48&navoid=2004

## Academic Integrity

Students and faculty at Ontario Tech University share an important responsibility to maintain the integrity of the teaching and learning relationship. This relationship is characterized by honesty, fairness and mutual respect for the aim and principles of the pursuit of education. Academic misconduct impedes the activities of the university community and is punishable by appropriate disciplinary action.

Students are expected to be familiar with and abide by Ontario Tech University's regulations on Academic Conduct which sets out the kinds of actions that constitute academic misconduct, including plagiarism, copying or allowing one's own work to copied, use of unauthorized aids in examinations and tests, submitting work prepared in collaboration with another student when such collaboration has not been authorized, among other academic offences. The regulations also describe the procedures for dealing with allegations, and the sanctions for any finding of academic misconduct, which can range from a resubmission of work to a failing grade to permanent expulsion from the university. A lack of familiarity with these regulations on academic conduct does not constitute a defense against its application. This information can be found at https://calendar.ontariotechu.ca/content.php?catoid=48&navoid=2004#academic-conduct-and-professional-suitability

Extra support services are available to all Ontario Tech University students in academic development, study skills, counseling, and peer mentorship. More information on student support services can be found at https://studentlife.ontariotechu.ca/services/academic-support/index.php

## Turnitin (if applicable)

Ontario Tech University and faculty members reserve the right to use electronic means to detect and help prevent plagiarism. Students agree that by taking this course all assignments are subject to submission for textual similarity review by Turnitin.com. Assignments submitted to Turnitin.com will be included as source documents in Turnitin.com's restricted access database solely for the purpose of detecting plagiarism in such documents. The instructor may require students to submit their assignments electronically to Turnitin.com or the instructor may submit questionable text on behalf of a student. The terms that apply to Ontario Tech University's use of the Turnitin.com service are described on the Turnitin.com website.

Students who do not wish to have their work submitted to Turnitin.com must provide with their assignment at the time of submission to the instructor a signed Turnitin.com Assignment Cover sheet: https://shared.uoit.ca/shared/department/academic-integrity/Forms/assignment-cover-sheet.pdf

## Online Test and Exam Proctoring (Virtual Proctoring)

Ontario Tech University will conduct virtual monitoring of examinations in accordance with Ontario privacy legislation and all approved policy instruments.

## Final Examinations (if applicable)

Final examinations are held during the final examination period at the end of the semester and when on campus access is allowed, may take place in a different room and on a different day from the regularly scheduled class. Check the published Examination Schedule for a complete list of days and times.

Students are required to show their Student ID card (campus ID) when in-person examinations are allowed. Students are advised to obtain their Student ID Card well in advance of the examination period as they will not be able to write their examinations without it. More information on ID cards can be found at https://registrar.ontariotechu.ca/campus-id/index.php.

Students who are unable to write a final examination when scheduled due to religious publications may make arrangements to write a deferred examination. These students are required to submit a Request for Accommodation for Religious Obligations to the Faculty concerned as soon as possible and no later than three weeks prior to the first day of the final examination period.

Further information on final examinations can be found at https://usgc.ontariotechu.ca/policy/policy-library/policies/academic/procedures-for-final-examination-administration.php

# Freedom of Information and Protection of Privacy Act

The following is an important notice regarding the process for submitting course assignments, quizzes, and other evaluative material in your courses in the Faculty of Science.

Ontario Tech University is governed by the Freedom of Information and Protection of Privacy Act ("FIPPA"). In addition to providing a mechanism for requesting records held by the university, this legislation also requires that the University not disclose the personal information of its students without their consent.

FIPPA's definition of "personal information" includes, among other things, documents that contain both your name and your Banner (student) ID. For example, this could include graded test papers or assignments. To ensure that your rights to privacy are protected, the Faculty of Science encourages you to use only your Banner ID on assignments or test papers being submitted for grading. This policy is intended to prevent the inadvertent disclosure of your information where graded papers are returned to groups of students at the same time. If you still wish to write both your name and your Banner ID on your tests and assignments, please be advised that Ontario Tech University will interpret this as an implied consent to the disclosure of your personal information in the normal course of returning graded materials to students.

If you have any questions or concerns relating to the new policy or the issue of implied consent addressed above, please contact accessandprivacy@ontariotechu.ca

Notice of Collection and Use of Personal Information Throughout this course, personal information may be collected through the use of certain technologies under the authority of the University of Ontario Institute of Technology Act, SO 2002, c. 8, Sch. O. and will be collected, protected, used, disclosed and retained in compliance with Ontario's Freedom of Information and Protection of Privacy Act R.S.O. 1990, c. F.31.

This course will use the following technologies that may collect, use, disclose and retain personal information (including images) for the purposes described below: [Instructors should edit this section according to the systems and technologies to be used in this specific course (e.g. If using Proctortrack, remove any reference to Respondus)] - Respondus Monitor and Proctortrack to maintain academic integrity for examinations; - Google Meet and Kaltura Virtual Classroom to facilitate remote instruction and interactive learning; - Peer-shared applications, services or technologies that may be reviewed, assessed, or used as part of coursework. - Other applications, services, or technologies that support or enhance online learning that include, but are not limited to, the following: [Instructor to list all relevant components]. For more information relating to these technologies, we encourage you to visit https://tlc.ontariotechu.ca Questions regarding personal information may be directed to: Ontario Tech University Access and Privacy Office, 2000 Simcoe Street North, Oshawa, ON L1G 0C5, email: accessandprivacy@ontariotechu.ca.

By remaining enrolled in this course, you acknowledge that you have read, understand, and agree to the terms and conditions under which the technology provider(s) may collect, use, disclose and retain your personal information. You agree to the university using the technologies and using your personal information for the purposes described in this course outline.

# Freedom of Expression

Pursuant to Ontario Tech's Freedom of Expression Policy all students are encouraged to express ideas and perspectives freely and respectfully in university space and in the online university environment, subject to certain limitations. Students are reminded that the limits on Freedom of Expression include speech or behaviour that: is illegal or interferes with the university's legal obligations; defames an individual or group; constitutes a threat, harassment or discrimination; is a breach of fiduciary, contractual, privacy or confidentiality obligations or commitments; and unduly disrupts and interferes with the functioning of the university. In the context of working online, different forms of communication are used. Where permitted, students using "chat" functions or other online forms of communication are encouraged to ensure that their communication complies with the Freedom of Expression Policy.

# Student Course Feedback Surveys

Student evaluation of teaching is a highly valued and helpful mechanism for monitoring the quality of Ontario Tech University's programs and instructional effectiveness. To that end, course evaluations are administered by an external company in an online, anonymous process during the last few weeks of classes. Students are encouraged to

participate actively in this process and will be notified of the dates. Notifications about course evaluations will be sent via e-mail, and posted on Canvas, Weekly News, and signage around the campus.