DEPARTMENT OF MATHEMATICAL AND COMPUTATIONAL SCIENCES
UNIVERSITY OF TORONTO MISSISSAUGA

CSC363H5S LEC9101
Computational Complexity and Computability
Course Outline - Winter 2021

Class Location & Time	Mon, 03:00 PM - 05:00 PM
Instructor	Mohammad Mahmoud
Office Location	virtual
Office Hours	Tue 10-11am
E-mail Address	mo.mahmoud@utoronto.ca
Course Web Site	https://q.utoronto.ca
Teaching Assistant	Yousef Akiba
Office Location	virtual
Office Hours	Thu 12-1pm
E-mail Address	yousef.akiba@mail.utoronto.ca
Teaching Assistant	Daniel Ceniceros
Office Location	virtual
Office Hours	Wed 3-4pm
E-mail Address	daniel.ceniceros@mail.utoronto.ca
Teaching Assistant	Muhammad Huzaifa
Office Location	virtual
Office Hours	Thu 10-11am
E-mail Address	m.huzaifa@mail.utoronto.ca
Teaching Assistant	Eric Lauw
Office Location	virtual
Office Hours	Thu 2-3pm
E-mail Address	eric.lauw@mail.utoronto.ca
Teaching Assistant	Paul Zhang
Office Location	virtual
Office Hours	Wed 5-6pm
E-mail Address	pol.zhang@mail.utoronto.ca

Course Description

Introduction to the theory of computability: Turing machines, Church's thesis, computable and non-computable functions, recursive and recursively enumerable sets, reducibility. Introduction to complexity theory: models of computation, P, NP, polynomial time reducibility, NP-completeness, further topics in complexity theory. [24L, 12T]

Prerequisite: (CSC290H5 and (CSC236H5 or CSC238H5)) or MAT202H5
Exclusion: CSCC63H3 or CSC463H1 (SCI)
Distribution Requirement: SCI

Students who lack a pre/co-requisite can be removed at any time unless they have received an explicit waiver from the department. The waiver form can be downloaded from here.

Learning Outcomes

- Rigorously handle the words 'computable', 'decidable', and 'solvable'
- Learn about models of computation including Turing machines, and how they all**compute** the exact same **functions;** hence the Church-Turing thesis
- Know what a 'computer' can/can't solve, know the Halting problem, and Hilbert's 10th problem
- Learn some answers to the following questions: What does it mean for a problem to be 'harder' than another? What does that mean from a computer's point of view? Are some 'unsolvable' problems more unsolvable than others? Are some 'solvable'

problems more 'complex' than others?
- Learn about **complexity** classes; time (runtime) and space (memory) complexities
- Learn about two main complexity classes: **P** and **NP**, and learn one way to become a millionaire, though definitely there are easier ways

Textbooks and Other Materials

We will be using lecture slides, but here are some references I would recommend:

I studied from this one during my PhD:
Soare, R. I. (2016). Turing Computability: Theory and Applications. Springer

The first I read:
Cooper, S. B. (2004). Computability theory. Boca Raton: Chapman & Hall/CRC.

A beautiful classic (2 volumes):
Odifreddi, P. (1989). Classical recursion theory: The theory of functions and sets of natural numbers. Amsterdam: North-Holland.

Used by previous instructors of this course:
Sipser, M. (2013). Introduction to the theory of computation.

Famous among programmers:
Cormen, Thomas H., et al. Introduction to Algorithms, Third Edition, MIT Press, 2009. ProQuest Ebook Central, https://ebookcentral-proquest-com.myaccess.library.utoronto.ca/lib/utoronto/detail.action?docID=3339142.

Assessment and Deadlines

Type	Description	Due Date	Weight
Quiz		2021-01-22	3%
Assignment		2021-01-29	10%
Quiz		2021-02-05	3%
Assignment		2021-02-12	10%
Quiz		2021-02-26	3%
Assignment		2021-03-05	10%
Quiz		2021-03-19	3%
Assignment		2021-03-26	10%
Quiz		2021-04-02	3%
Assignment		2021-04-09	10%
Final Exam		TBA	35%
		Total	100%

More Details for Assessment and Deadlines

The quizzes are designed to reward you for keeping up with the course. Each quiz will be 3 simple questions to check your understanding of the main concepts. You will be given 30 mins but likely won't need more than 20 mins, and you may start the quiz anytime on its day.

Both quizzes and assignments will be due on Fridays before midnight (before it is Saturday).

All assessments will be open book.

You need to score at least a 40% on the final exam to pass the course. Students scoring less than 40% on the final exam will receive a maximum final grade of 47%

Penalties for Lateness

20% per day of lateness.

Procedures and Rules

Missed Term Work

In order to receive special consideration, you must email supporting documentation to your instructor. You must also declare your absence on Acorn.

In case of illness, bring a U of T medical certificate to the instructor within one week of the missed work. The certificate must specify the exact period during which you were unable to carry out your academic work.

Missed Final Exam

Students who cannot complete their final examination due to illness or other serious causes must file an online petition **within 72 hours of the missed examination**. Late petitions will **NOT** be considered. Students must also record their absence on ACORN on the day of the missed exam or by the day after at the latest. Upon approval of a deferred exam request, a non-refundable fee of $70 is required for each examination approved.

Academic Integrity

Honesty and fairness are fundamental to the University of Toronto's mission. Plagiarism is a form of academic fraud and is treated very seriously. The work that you submit must be your own and cannot contain anyone elses work or ideas without proper attribution. You are expected to read the handout How not to plagiarize (http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize) and to be familiar with the Code of behaviour on academic matters, which is linked from the UTM calendar under the link Codes and policies.

Final Exam Information

Duration:	3 hours
Aids Permitted:	Open book (Textbook)

Additional Information

If you have questions, please post them on Piazza instead of emailing the instructor or the TAs. Your posts can be private, or public and anonymous to classmates. You may send an email (using your @mail.utoronto.ca account) in case your question is not answered for long time (several days, or an urgent matter).

Last Date to drop course from Academic Record and GPA is March 15, 2021.