CSC 463: Computational Complexity and Computability
Winter 2022

Instructor: Shubhangi Saraf (shubhangi.saraf@utoronto.ca)

Webpage: https://www.math.toronto.edu/ssaraf/csc463-winter-2022/

Teaching Assistants: Deepanshu Kush, Harry Sha, Pouya Shati

Lectures: Mondays 2 pm - 4 pm in SF 3202 (iTill Jan 31 on zoom)

Tutorials: Wednesday 2pm - 3pm

Office Hours: Thursday 1pm- 2 pm via zoom

Instructor Email: `shubhangi.saraf@utoronto.ca`

Course Contents and Objectives: By the end of the course students should be able to

- Define various complexity classes (eg. decidable problems, NP, PSPACE, NL), and prove properties about these classes and problems belonging to them.
- Gain an appreciation for theoretical computer science and understand its connections to other subfields within computer science, mathematics, and other sciences.

Specifically the course content will include:

- Computability Theory (5 weeks): Turing machines, Church's Thesis, decidability and semi-decidability, diagonal arguments, the Halting Problem and other undecidable problems, reductions, complete problems.
- Computational Complexity (7 weeks): The classes P and NP, polynomial time reducibility, NP-completeness, Cook-Levin Theorem, various NP-complete problems, space complexity (NL and PSPACE), intractable problems, other topics.

Course Materials: The recommended course textbook is Michael Sipser, "Introduction to the Theory of Computation", 2nd or 3rd edition. The course contents will correspond to parts of Chapter 3-10 of this textbook (in either edition).

Class announcements will be posted on the course Quercus page.

A course Piazza will also be made available for discussions about course material. Please use Piazza rather than email for help related to understanding the course material.

References: These books may be useful to students seeking additional reading about the course topics.

- S. Arora and B. Barak. *Computational Complexity: A Modern Approach.*
- M. Garey and D. Johnson. *Computers and Intractability: A Guide to the Theory of NP-Completeness.*

Marking Scheme: There will 5 problem sets. The lowest problem set score will be dropped. The highest 4 problem sets will each count for 10% of the grade. There will be one take-home midterm exam worth 20% of the grade and one final exam worth 40% of the final grade (date: TBD). If an in-person final exam is not possible, it will be a take-home final exam.

technical requirement

In order to participate in this course, students will be required to have:

- Reliable internet access. It is recommended that students have a high speed broadband connection (LAN, Cable, or DSL) with a minimum download speed of 5 Mbps.
- A computer satisfying the minimum technical requirements:
  https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/

Other recommended items include headphones, microphone, webcam, and a tablet or printer.

If you are facing financial hardship, you are encouraged to contact your college or divisional registrar (https://future.utoronto students/registrars/) to apply for an emergency bursary.

late problem sets will be marked 0%.

submission The problem sets will be sent to you via Crowdmark.

You will be asked to submit your solutions electronically on Crowdmark. No paper copy will be accepted.

The easiest way to upload your problem set is to use a scanner, but if you don't have access to one, you can also use a scanner app on your phone. Make sure that your work is legible before submitting it; otherwise, it will not be accepted.

solutions Written solutions are not provided, but some of them will be discussed in tutorials. You are encouraged to consult with TAs, your fellow students, and the instructors to identify shortcomings in your grasp of the material.

missed midterm There will be no make-up midterm exam. For students who missed the midterm exam because of illness or any other approved legitimate reason, its weight will be transferred to the final exam.

Homework and Accommodation Policy: You may discuss homework problems with each other; however, you should prepare written solutions alone. Copying assignments is a serious academic offense and will be dealt with accordingly.

Students with diverse learning styles and needs are welcome in this course. In particular, if you have considerations that may require accommodations, please feel free to approach the instructor by email and/or Accessibility Services at (416) 978 8060; `studentlife.utoronto.ca/as`.

Course Tutorials: Course tutorials will be lead by the teaching assistants. The course tutorial may include practice with solving problems related to the course material and/or help with the course assignments. You are encouraged participate actively in course tutorials to support your learning in the course.

Course Policies

Policy on Missed Term Work

As flexibility for missed or late course assignments have been built into the marking scheme, late and missed assignments will not be accepted for any reason.

Please note that Verification of Illness forms(also known as a "doctor's note") are temporarily not required.Students who are absent from class forany reason(e.g., COVID, cold, flu and other illness or injury, family situation) and who require consideration for missed academic work should report their absence through the online absence declaration. The declaration is available onACORNunder the Profile and Settings menu.

If you miss a term test or the final assessment, then you must inform your course Instructor within 72 hours of the test. No exceptions. If your request is approved, you may receive an accommodation in the form of an oral exam, written make-up test, or a re-weighting of your assessments.

Turnitin

Turnitin may be used for detecting plagiarism in some of the written work submitted in this course. Normally, students will be required to submit written work to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

Email Policy

Should you have a question that is not answered on the course site (please check there first!) please note that all communications with the Course Instructor or TA's must be sent from your official utoronto email address, with the course number included in the subject line. If these instructions are not followed, your email may not be responded to.

Policy on Wearing Masks in Class

Masks are an inexpensive and effective measure that limits the spread of COVID and will facilitate the return to normal life as quickly as possible. Failure to wear a mask properly entails unnecessary risks to public health and may disrupt learning by creating unwelcome distractions. In-person instruction cannot take place unless all students are wearing a mask that covers both mouth and nose, with exceptions only for students who have received documented exemptions.

As with other accommodations, any student who has an official exemption from wearing a mask is expected inform the instructor BEFORE classes begin by providing documentation.

This policy is in line with the University's mask requirement: https://www.provost.utoronto.ca/planning-policy/joint-provostial-and-human-resources-guideline-on-facemasks-at-the-university-of-toronto/#section_0

Institutional Policies and Support

Academic Integrity

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to your Course Instructor. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the University of Toronto website on Academic Integrity).

Copyright Some of the lectures for this course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation, and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.

For questions about recording and use of videos in which you appear please contact your instructor.

Students may not create audio recordings of classes with the exception of those students requiring an accommodation for a disability, who should speak to the instructor prior to beginning to record lectures.

Students creating unauthorized audio recording of lectures violate an instructor's intellectual property rights and the Canadian Copyright Act. Students violating this agreement will be subject to disciplinary actions under the Code of Student Conduct.

Course videos may not be reproduced or posted or shared anywhere other than the official course Quercus site and should only be used by students currently registered in the course. Recordings may be saved to students' laptop for personal use.

Because recordings will be provided, students may not create additional audio or video recordings without written permission from the instructor. Permission for such recordings will not be withheld for students with accommodation needs.

Accessibility

The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges

a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs. Students with diverse learning styles and needs are welcome in this course. If you have a disability that may require accommodations, please feel free to approach your Course Instructor and/or the Accessibility Services office as soon as possible. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

Link to Accessibility Services website: https://studentlife.utoronto.ca/department/accessibility-services/

Equity, Diversity and Inclusion The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

Important Academic Dates & Deadlines

The academic dates include enrollment dates, drop deadlines, exam periods, petition deadlines and more.

https://www.artsci.utoronto.ca/current/dates-deadlines/academic-dates

Other Academic and Personal Supports

- Writing Centre https://writing.utoronto.ca/writing-centres/arts-and-science/
- U of T Libraries https://onesearch.library.utoronto.ca/
- Feeling Distressed? https://studentlife.utoronto.ca/task/support-when-you-feel-distressed/
- Academic Success Centre https://studentlife.utoronto.ca/department/academic-success/
- College/Faculty Registrars https://future.utoronto.ca/current-students/registrars/