CSC 463: Computational Complexity and Computability
Winter 2020

Instructor: Adrian She

Teaching Assistants: Gregory Rosenthal, Pouya Shati

Lectures: MWF 2-3pm in GB 221

Office Hours: Tuesday 3-4pm in BA2283, or by appointment

Course Email: `csc463-2020-01@cs.toronto.edu`

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).

Supplementary notes for some topics, problem sets, and tutorial sheets will be posted on the course website (`http://www.cs.toronto.edu/~ashe/463.html`). Class announcements will be posted on the course Quercus or Piazza pages.

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: Your course mark will be based on 4 assignments (10% each, tentatively due Jan 31, Feb 14, Mar 13, Mar 27), a midterm exam (20%, Feb 26), and a final exam (40%, date TBD).

Homework and Accomodation 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.`

Extensions to assignments due dates may be granted due to students' physical or mental health issues, accommodations from Accessibility Services, or other extenuating circumstances, without penalty to

their mark provided they are requested at least a day before the assignment due date. In a case where an extension is granted, students will be asked to refrain from attending the course tutorial where solutions to the course assignments will be discussed.

Course Tutorials: The Friday lecture will often be used for a course tutorial 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.

(Updated Feb 4, 2020)