Course Information

ECE 345 Algorithms and Data Structures

University of Toronto

Dept. of Electrical and Computer Engineering
Fall Semester, 2020

Course Description

Design and analysis of algorithms and data structures are essential to engineers in every aspect of the computer hardware and software industry. The course content covers recurrences, asymptotics, summations, trees and graphs, sorting, search trees, amortized analysis, hash functions, dynamic programming, greedy algorithms, basic graph algorithms, minimum spanning trees, shortest paths, maximum flow, introduction to NP-completeness and new trends in algorithms and data structures.

The course introduces the basics of computational complexity analysis and various algorithm design paradigms. The goal is to provide students with solid foundations to deal with a wide variety of computational problems, and to provide a thorough knowledge of the most common algorithms and data structures. This is **not** a programming class, but one that helps student identify characteristics of problems, and model them using the appropriate algorithms/data structures, as well as analyze the performance of the underlying formulation.

Staff

Section 1: Professor Andreas Veneris, SF-2001 (`veneris@eecg.toronto.edu`).

Section 2: Zissis Poulos, Rotman School of Management-3001 (`zpoulos@eecg.toronto.edu`).
Office hours: Thursday, 11am - 12pm (Virtual) or physical meeting by appointment only.

The head TA's for this course are:
Nick Fung (`nickfung247@gmail.com`)
Keerthi Nelaturu (`keerthi.nelaturu@mail.utoronto.ca`).
Office hours: Monday, 11am - 12pm (Virtual), physical meeting by appointment only.

ECF Course Email: ece345i@ecf.utoronto.ca (Course email to be used for general inquiries like questions on material and remarking. This email address goes to TA's only and not to prof's)

Videos and Virtual Sessions

All lecture videos will be pre-recorded and made available on Quercus come early September.
Students are expected to view the lecture videos, and study the corresponding material prior to the virtual live Q&A sessions.

The allocated lecture time is for Q&A only. An instructor will be available to answer questions from the students. The virtual live Q&A sessions will be delivered through BBCollaborate. Please make sure you have set up your machine prior to the sessions, more information can be found on Blackboard Collaborate Ultra.

The virtual live Q&A lecture session schedule is as following:

LEC0101: Mon (11am-12pm).

LEC0102: Fri (11am-12pm).

Each student is registered in one of the four tutorial sections. In tutorials, we will answer questions about the lecture material, address homework material and solve some sample problems from the textbook. Similar to the lectures, tutorial videos are pre-recorded and are available on Quercus based on the schedule. During the scheduled tutorial

time slot, a tutorial TA will be available to address questions from the students. The virtual live Q&A tutorial sessions will be delivered through BBCollaborate.

TUT0101 runs on Mon (10am-11am).

TUT0102 runs on Thu (10am-11am).

TUT0103 runs on Wed (4pm-5pm).

TUT0104 runs on Wed (12pm-1pm).

Tutorials begin on Monday, September 14th.

Textbook and Class Contents

The required textbook for this course is T. Cormen, C. Leiserson, R. Rivest, C. Stein (CLRS), "*Introduction to Algorithms*," McGraw Hill 2009 (3rd edition). CLRS is a well-written comprehensive textbook used by most major universities. No other text is required and no lecture notes will be distributed.

In this class we will cover the following material:

- Background: asymptotics, recurrences, combinatorics, randomization, graphs and trees (Chapters 1...5, Appendices A, B and C)
- Sorting: quicksort and analysis, heapsort and analysis, other sorting methods, lower bounds in sorting and selection in linear time (Chapters 6...9)
- Binary Search trees, Red-Black trees, Amortized Analysis, Splay trees, Hashing (Chapters 10...13, 17)
- Dynamic Programming and Greedy Algorithms (Chapters 15 and 16)
- Basic graph algorithms (breadth-first search, depth-first search) (Chapter 22)
- Minimum Spanning Trees, Single Source Shortest Paths and Max Flow (Chapters 23, 24 and 26)
- Introduction to the theory of computation and NP-Completeness (Chapter 34)
- Introduction to Blockchain Technologies

Webpage and Bulletin Board

All official announcements will be posted on Quercus (q.utoronto.ca). *It is your own responsibility to check it at regular intervals, i.e., once per day.* Questions on the material (*i.e.,* lectures, exams, labs etc) are welcomed on the discussion board. **No solutions to problems should be posted by students on the board.** Only the instructors and TAs may post solutions. Please do not use the board for any posts other than those relating to the course.

On Quercus you will also be able to find the lecture videos, tutorial videos, reading assignments, homeworks, sample problem solutions, previous exams and other useful resources.

A weekly schedule of videos will be posted on Quercus at the beginning of the semester.

Course Requirements and Grading Scheme

The final grade for this class has three components:

- **homeworks:** There will be five homeworks you will do in groups of 2-3 students. You can switch groups between homeworks but you will receive the group grade each time. More details about proper homework submission are on the WWW. Deadlines for homeworks are final! *Absolutely no late homework will be accepted.* For each

homework, each group should compose a single PDF file. One of the group members should submit a single file of all the pages of the homework through Quercus before the deadline. Either a scanned copy of a hand-written solution or a file generated with LaTeX are acceptable. Homeworks account for 25% of your grade.

- **midterm exam:** There will be one midterm and it is open CLRS book. The midterm accounts for 35% of the grade.
- **final exam:** Open CLRS book and 40% of the grade.

Note: Detailed instructions for homeworks and exams can be found in additional handouts posted on Quercus. Please read them and observe them carefully, that is, how to prepare/submit your homework/exams. You need adhere to those instructions or you may not receive a mark for the particular assignment if you don't.

Exam dates will be announced at a later time. Exam material will be much simpler versions of the problems you will see in the homeworks. Exam type material will be practiced regularly at tutorials.

Remarking: You have exactly *seven* (7) working days to submit your work (homework or midterm) for remarking from the time we release it to you. An Exact time when assignments are returned will be promptly announced on Quercus. *There are NO exceptions to this rule and no late homework will be remarked.* For remarking the midterm, you will need to send an email to the ECF course email (ece345i@ecf.utoronto.ca) in which you clearly indicate the reason you believe you were marked unfairly. If there is a legitimate reason for a late assignment or exam absence (illness, etc.), discuss the matter with the instructor. Keep in mind that official documentation must always be provided (*i.e.,* doctor letter etc).

Cheating Policy

Cheating is against "fair–play" and will not be tolerated under any circumstances. While the pressures of many classes, homeworks, work and/or extracurricular activities can be great, this is *never* an excuse for copying solutions from others. **The University holds among its highest principles the notion of academic freedom and integrity. Cheaters will face the University's disciplinary committee as well as receive a failing grade in this course.** If you think that there is an issue that influences your performance in the class then talk to the instructor.

How to Get the Most out of this Course

You are urged to read the text, as it is quite thorough, with many examples and with good motivating discussions and intuitions. The WWW is full of additional scientific and historical material. Do a lot of practice problems from the book. Read the bulletin board regularly and post questions! Attend lectures, tutorials and office hours. Keep up with the pace of the class.

Copyright and FIPPA

Notice of video recording and sharing (Download permissible; re-use prohibited) 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 source depending on the specific facts of each situation, and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. For questions about recording and use of videos in which you appear please contact your instructor.