Comp 160: Algorithms, Fall 2019

Tufts University

Introduction

Welcome! This 1-page summary contains a quick overview of the contents course and how they will be taught. Make sure to keep a copy in your notes and to check it regularly!

Goals

The main goals of the course are:

A Understand the importance of rigorous proofs

B Realize how complex algorithms can be

C Internalize that good coding practices start with a planning step

Objectives

Thinks you will learn in the course:

1. Describe a selection of classic algorithms
2. Restate proof of correctness in ideal settings
3. List the settings in which each of the algorithms can be used
4. Categorize the main tools used for proving, and the different steps of each one
5. Summarize the advantages and disadvantages of classic algorithms
6. Given a new problem setting, Extract the important features
7. Decide which of the classic algorithms is the most helpful for this new setting
8. Modify existing algorithms so that they can work in more general settings
9. Prove that modified classic algorithms will work in a new setting

Content

The contents of the course are split into three big blocks:

Block 1: Sorting

- InsertionSort, MergeSort
- big O and Ω notation
- Recurrences by trees and substitution.
- Master method.
- Deterministic selection (median-finding)
- Sorting lower bound
- CountingSort and RadixSort
- IRV and QuickSort Analysis
- Randomized Selection

Block 2: Data Structures

- Hashing
- BST and relationship to QuickSort
- Red-Black trees
- Augmented trees
- Dynamic Programming
- Amortization

Block 3: Graphs and NP-hardness

- BFS, DFS
- Topological sort and SCC
- Kruskal's algorithm
- Prim's algorithm
- SSSP
- NP-hardness
- Reductions
- Approximation

Non-content content

Other topics discussed in class:

- Using LaTeX to write documents
- How to write good proofs
- How to nail an internship interview
- Synthesizing texts
- Becoming an expert in CS

Assessments

During the semester we will provide several tools so that students can get an idea of how well they are doing in class:

In class assignments

- Discussion: what makes a good proof?
- In class discussion: explain to your peers
- Recitation: work in groups to solve questions

Outside class assignments

- Weekly homework assignments
- Sporadic programming assignments

Tests

- Midterm exam at the end of each block
- Final exam

Student Feedback

- One minute takeaway at end of each class

On attendance

Although we **strongly** encourage students to actively participate in both lectures and recitation, we will not check for attendance nor it will have any direct influence your grade.

You are welcome to use the slides and lecture recording of the previous instructor (Prof. Greg Aloupis), but please note that this material is for reference only.

Students are responsible for knowing what was taught during this semester, which will include the instructors variations. The course **will** have topics that have not been recorded and those topics will come in the exam. In other words, please come to class.

About the instructors

The course is led by Matias Korman: I got a Ph.D. in computer science in 2009 in Japan. My topic of research is computational geometry. You will learn more about me in class, but for that you will have to do your homework!

Karen Edwards is the course coordinator: I am a transplant both from California and from mathematics, which is my background. I've been teaching for over 25 years at many institutions and have loved working in the Tufts CS community.

In addition to the two of us, we have a large pool of very motivated TAs. Treat them nicely and they will make sure you learn as much as possible!

Grading Rubric

Homework (and exam questions) will be graded with the following categories in mind. Here we show how they correspond to an 8 point scale:

Excellent grade (8-7 points)

A student must show all or most of the following items:

- Chose an appropriate technique to solve the problem
- A good justification was given
- Any modifications to the core technique (if any are needed) are clearly stated
- The algorithm cover all cases
- Proof is clear and well structured
- Clear mastery of the concepts related to the assignment

Fair Grade (6-4 points)

- Chose a reasonable technique to solve the problem
- Some justification was given
- Modifications to the technique (if any are needed) are mentioned but not clear
- The algorithm works in most cases
- Proof is reasonably structured
- A general understanding of the concepts related to the assignment

Low Grade (3 points or lower)

- The student chose an incorrect technique to solve the problem
- No (or an incorrect) justification was given
- The modifications to the technique (if any are needed) are vague or missing
- The algorithm is missing some critical cases
- Proof is unclear and/or hard to follow
- Overall, the student did not grasp the concepts related to the assignment

Naturally, the rubric will be adapted to each particular question (for example, if we specifically asks you to use a certain technique, the focus of the grade will be on that technique).

Grading

Your final grade will depend on the following factors:

Text-based assignments There will be one assignment per week, and in total they will be **20% of the final grade**. We recommend using LaTex as this is the nearly universal typesetting language of the field (see course's webpage for more information).

Coding assignments In addition to paper based assignments, we may release a small number of coding assignments. These assignments are **optional** and can only increase your grade.

In class exams There will be one exam at the end of each block. **Each exam is 20% of the final grade** and will only cover the contents of that block.

Final Exam By the end of the semester in the usual Tufts exam period we will have a 2 hours long exam. The exam will cover all material in the course and will be worth **20% of the final grade**.

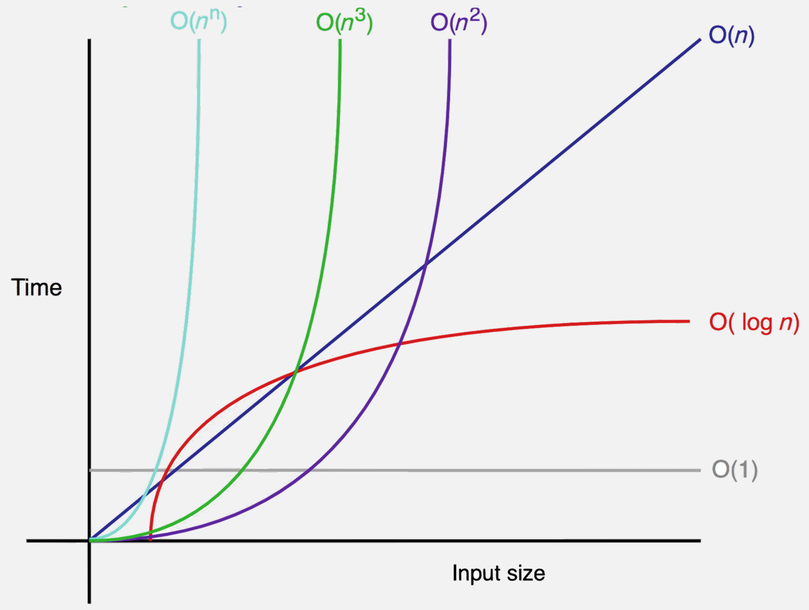

Figure: Understanding the asymptotic behavior of different algorithms is a key concept of the course.

Requesting regrades

Keep in mind that **the main goal of any assignments is for you to know how are you doing in the course**: did you understand the concepts explained in class? Can you reproduce them on your own? and so on.

We understand that as a student you may also be interested in the numerical grade that you will get from taking this course. We will do our best to give you a fair assessment, but please understand we are humans and can make mistakes.

If you feel that the numerical grade of any assignment does not reflect properly your work, you can send a regrade request via Gradescope. We tend to frown on requests that simply state *please give me more points so I can get a B+*. Instead, we would suggest that you look at the feedback you received, and compare your work with the solution. State your opinion on what has been incorrectly graded and why. The person that graded your assignment will get back to you soon.

More information

A great source of information is the course's website (available at `http://www.cs.tufts.edu/comp/160/`). If you still have questions, we can be reached in the following ways:

In class Just come chat with the instructor before/after lectures.

Office hours We have TAs doing office hours at most times of the day (exact schedule is be posted in the course's website). The instructor of the course (Matias Korman) also has office hours in his office (228D) on Mondays (16:30-17:45) and Tuesdays (15:00-16:15).

Piazza The code for joining this discussion forum will be given in class. Homework assignments will only be posted there, so joining is a must! The main advantage of posting on Piazza over e-mail is that TAs or fellow students will also see the questions and can answer them much faster.

E-mail If all of the above methods fail, you can reach me at `matias.korman@tufts.edu`. Please understand that I this e-mail address is loosely monitored and should NOT be used for urgent issues. Any of the above methods are better methods are a much to get a faster response.

Textbook

The course follows closely the contents of *Introduction to algorithms* book, written by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein (for brevity, we often refer to it as the CLRS). Each week we will point to specific sections of CLRS that are related to the topics discussed in class. Two copies of the book have been permanently reserved at Tufts Tisch library specifically for Comp 160 students. If you are having troubles accessing a copy, let us know and we can request additional ones.