Lecture 1

CS 161 Design and Analysis of Algorithms

Ioannis Panageas

Course staff

Instructor: Ioannis Panageas
Email: ipanagea at ics dot uci dot edu
Office hours: Wednesday 2:00-4:00pm (zoom)

Head TA: Navin Velazco (any requests)

Email: nvelazco at uci dot edu
Office hours: Monday 12:00-1:00pm (zoom)

TAs:
Parnian Shahkar (shahkarp at uci dot edu)
Office hours: Friday 5:00-6:00pm (zoom)

Nikolas Patris (npatris at uci dot edu)
Office hours: Wednesday 1:00-2:00pm (zoom)

Stelios Stavroulakis (sstavrou at uci dot edu)
Office hours: Wednesday 11:00-12:00pm (zoom)

Course material

We will use canvas for announcements. Slide materials will be posted on
https://panageas.github.io/algo2024.html

We will use gradescope for posting homeworks and grading.

We will be using Edstem for questions of general interest about the course material, the homework, and the tests
https://edstem.org/us/courses/57731/discussion/

Required Textbook

- Algorithm Design and Applications, by M. T. Goodrich and R. Tamassia.

Recommended Textbook

- Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

Grading

- Homeworks: 20%
  - There will be given 4 Homeworks to solve (+5% bonus for Homework 5).
- Midterms: 20+20+20%
  - There will be given 3 midterms, on Tuesdays of week 4,6 and 9. Each midterm will contain topics from previous weeks.
- Final : 20%
  - Material from all weeks (except last week).

+1% for Course Evaluation

Letter Grades

- Not a straight scale nor straight curve

- 90% and up guaranteed some sort of A or A-
- 80% and up guaranteed at least B-
- 70% and up guaranteed at least C-

Submitting Assignments

- Written assignments in Gradescope
  - Must be legible
    - If you have messy handwriting, type your homework!
    - Bonus 5% for Homework 5!
  - Must be on-time.
  - Deadline: Fridays 23:59pm (see syllabus)

- Programming assignments optional in Gradescope
  - Code must be in python and need to pass test cases

Exam Dates and Rules

- The exams are held on the days listed (syllabus)
  - See policy in syllabus, **no** makeup exams
- Exams will not be excused for reasons within your control.
- If there is a valid reason (needs approval from instructor) for missing an exam, the grade will be **split equally** among the other components.

Academic Integrity Policy

- If you need help, see:
  - Ioannis
  - TAs
- Plagiarism risks an F in the class and more.
- The following are examples of **not okay:**
  - Chegg GeeksForGeeks
  - CourseHero Quora
  - StackOverflow Github (generally)
  - Chatgpt or related platform

Collaboration with classmates

- You can discuss some things freely with others:
  - What a problem is asking
  - How to do a non-homework or non-exam problem
  - How something from lecture worked
- You should **never**:
  - Show your homework assignment to someone else
  - Write your solutions from notes taken outside lecture / discussion
  - Seek homework solutions from outside sources -- especially online!
  - Tell a student specifically how to solve a homework problem
- Penalty for academic dishonesty: F in the course.

To-Do This Week

- Read the syllabus
  - Treat it as though it's a reading assignment.
  - Main document plus associated policy documents
- Review Prerequisites
  - Help is available all week, including at all discussion sections

What is algorithm

- Algorithm is a procedure for solving a task

e.g. how do you sort a cart of books in increasing order of the volume number? (i.e. volume 1, volume 2, volume 3….)

- Bad algorithm: compare all books, put smallest volume in the beginning and repeat.

- Clever algorithm: divide the cart into two, sort the first half, sort the second half, merge them.

What is algorithm

- Algorithm is a procedure for solving a task

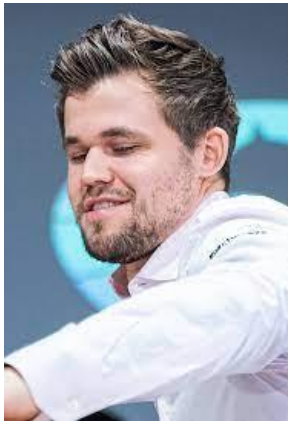
e.g. How to find the best travelling time between from a station to any other station?

- Bad algorithm: manually find the travelling between each station.
- Clever algorithm: just record the travelling time between consecutive stations, then use the Dijkstra shortest path algorithm.

Case study I: Finding a Celebrity

Since coming to UC Irvine, has anyone met a celebrity?






What is a celebrity?

- Within a group of people *G*,
  we say a person *p* is a celebrity (famous) if:
  - Everyone knows who *p* is
    (celebrities must be known by everyone)
  - Person *p* does not know who anyone else is

- Goal: Find a celebrity from *G* if there exists one.

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- Goal: Find a celebrity from *G* if there exists one.

- You are allowed to only query if person i knows person j for various choices of (i, j).

Brute force approach

- Given a person *p* we want to check if it is a celebrity
  - How efficiently can I check if person *p* is a celebrity? # of queries

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This gives $2n - 2$ queries where n is the group size.

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  - We have to do the above for all possible persons *p*.

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Can we do better?

Faster approach

- Put all the members in a list (arbitrary order)
  - Pick the first two members of the list, let *p, q.*
  - Query if *p knows q.*

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  2 Cases:

  1. *p knows q.* Then *p* is not a celebrity (remove *p* from the list).
  2. *p does not know q.* Then *q* is not a celebrity (remove *q* from the list).

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  - Repeat the above process. At every iterate, we remove one person.

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$$\text{After } n-1 \text{ "iterates" we have } \mathbf{one} \text{ member in the list.}$$

Check if this remaining person is a celebrity.

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Check if this remaining person is a celebrity. Why do you need to check?

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$$\text{Total queries are } 2n-2+n-1 = 3n-3 \text{ which gives } \Theta(n) \ .$$

Case study II: Finding the heaviest and lightest item

- We are given a set of *n items of different weights*:

$$x_1, x_2, \dots, x_n$$

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- You are allowed to only compare x_i with x_j for various choices of i, j.

Brute force approach

- Find the heaviest item among $x_1, x_2, \ldots, x_n$. How many comparisons?

Brute force approach

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Brute force approach

- Find the heaviest item among $x_1, x_2, \ldots, x_n$. $n-1$
- Find the lightest item among $x_1, x_2, \ldots, x_n$. How many comparisons?

Brute force approach

- Find the heaviest item among $x_1, x_2, \ldots, x_n$. $n-1$
- Find the lightest item among $x_1, x_2, \ldots, x_n$. $n-1$

Brute force approach

- Find the heaviest item among $x_1, x_2, \ldots, x_n$. $n-1$
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Total number of comparisons $2(n-1)$.

Brute force approach

- Find the heaviest item among $x_1, x_2, \ldots, x_n$. $n-1$
- Find the lightest item among $x_1, x_2, \ldots, x_n$. $n-1$

Total number of comparisons $2(n-1)$. You may get $2n-3$.

Can we do better?

Faster approach

- Compare x_1 with x_2, x_3 with x_4 etc (like round 1 of knock-out tournament).

Total number of comparisons $\frac{n}{2}$.

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- Find heaviest among winners of round 1. $\frac{n}{2} - 1$

- Find lightest among losers of round 1. $\frac{n}{2} - 1$

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Total number of comparisons $\frac{n}{2}$.

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- Find lightes

 # comparisons $\frac{3n}{2}$ - 2