CSE 431/531B: Algorithm Analysis and Design (Fall 2023)
Introduction and Syllabus

Lecturer: Kelin Luo

Department of Computer Science and Engineering
University at Buffalo

Outline

1. Syllabus
2. Introduction
   - What is an Algorithm?
   - Example: Insertion Sort
   - Analysis of Insertion Sort
3. Asymptotic Notations
4. Common Running times

CSE 431/531 B: Algorithm Analysis and Design

- Course Webpage (contains schedule, policies, and slides): https://cse.buffalo.edu/~kelinluo/teaching/cse431B-531B-fall23/index.html

- Please sign up course on Piazza via link https://piazza.com/buffalo/fall2023/cse431531b on course webpage
  - homeworks, solutions, announcements, polls, asking/answering questions

Acknowledgement: The course design and information primarily draw inspiration from Prof. Shi Li's Algorithm Analysis and Design course in Fall 2022.

- Time & Location : Mon-Wed-Fri, 2:00pm - 2:50pm, Norton 190
- Instructor: Kelin Luo, kelinluo@buffalo.edu
- TAs:
  - Yifan Yang, yyang99@buffalo.edu
  - Sayem Khan, skhan61@buffalo.edu
  - Yuxin Liu, yuxinliu@buffalo.edu
- Office hour

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- Some Programming Experience
  - e.g. Python, C, C++ or Java

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- NP-completeness

Tentative Schedule

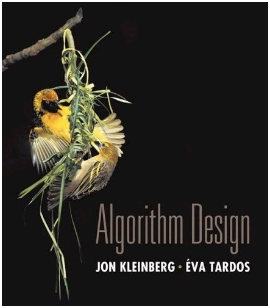
- 50 Minutes/Lecture $\times$ 41 Lectures

Introduction	3 lectures
Graph Basics	4 lectures
Greedy Algorithms	6 lectures
Divide and Conquer	6 lectures
Dynamic Programming	8 lectures
Graph Algorithms	7 lectures
NP-Completeness	4 lectures
Final Review	3 lectures

Textbook

Textbook (Highly Recommended):

- Algorithm Design, 1st Edition, by *Jon Kleinberg* and *Eva Tardos*



Other Reference Books

- Introduction to Algorithms, Third Edition, *Thomas Cormen, Charles Leiserson, Rondald Rivest, Clifford Stein*

Reading Before Classes

- Highly recommended: read the correspondent sections from the textbook (or reference book) before classes
  - Sections for each lecture can be found on the course webpage.
- Slides are posted on course webpage. They may get updated after the classes.
- In last lecture of a major topic (Greedy Algorithms, Divide and Conquer, Dynamic Programming, Graph Algorithms), I will discuss exercise problems, which will be posted on the course webpage before class.

Grading

- 5% for participation
  - In-class discussions or quizzes will be given randomly. (We choose the best 5 scores out of 8-10 quizzes.)
- 40% for theory homeworks
  - 8 points $\times$ 5 theory homeworks (We choose the best 5 scores out of 6 homeworks.) (Recommendation: typed submissions, e.g. latex.)
- 20% for programming projects
  - 10 points $\times$ 2 programming assignments
- 35% for final exam (closed-book, closed-note)

For Homeworks, You Are Allowed to

- Use course materials (textbook, reference books, lecture notes, etc)
- Post questions on Piazza
- Ask me or TAs for hints
- Collaborate with classmates
  - Think about each problem for enough time before discussions
  - Must write down solutions on your own, in your own words
  - Write down names of students you collaborated with

For Homeworks, You Are Not Allowed to

- Use external resources
  - Can't Google or ask questions online for solutions
  - Can't read posted solutions from other algorithm course webpages
- Copy solutions from other students
- Use of Artificial Intelligence Technologies like OpenAI's ChatGPT, Google Bard, and AI models within search interfaces like Google or Bing, etc.

For Programming Projects

- Use Python3
- Need to implement the algorithms by yourself
- Can not copy codes from others or the Internet
- We use Moss (`https://theory.stanford.edu/~aiken/moss/`) to detect similarity of programs

Late Policy

- No late submissions will be accepted.
- 11:59PM EST. Please submit it before the deadline.

Academic Integrity (AI) Policy for the Course

- minor violation:
  - 0 score for the involved homework/prog. assignment, and
  - 1-letter grade down
- 2 minor violations = 1 major violation
  - failure for the course
  - case will be reported to the department and university
  - further sanctions may include a dishonesty mark on transcript or expulsion from university

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Course Sign up

- Last Day to Drop/Add a Course: September 05
- Resign Date: November 10

Questions, please go to Piazza!

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- Computational problem: specifies the input/output relationship.
- An algorithm solves a computational problem if it produces the correct output for any given input.

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Input: two integers $a, b > 0$

Output: the greatest common divisor of a and b

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- $(270, 210) \to (210, 60) \to (60, 30) \to (30, 0)$

Examples

Sorting

Input: sequence of n numbers $(a_1, a_2, \cdots, a_n)$

Output: a permutation $(a'_1, a'_2, \cdots, a'_n)$ of the input sequence such that $a'_1 \leq a'_2 \leq \cdots \leq a'_n$

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- Algorithms: insertion sort, merge sort, quicksort, ...

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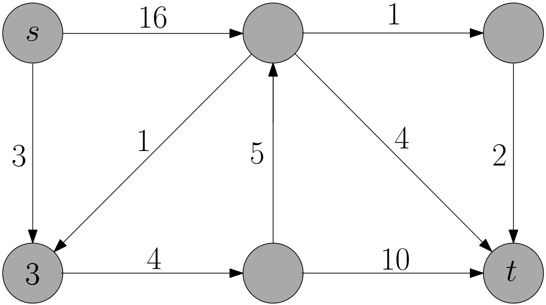

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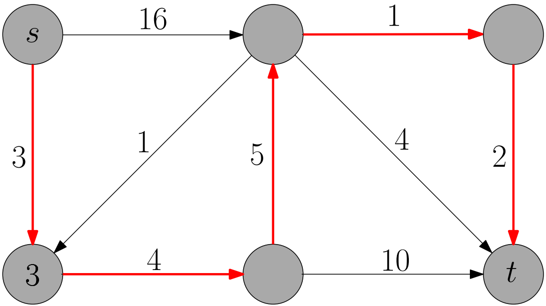

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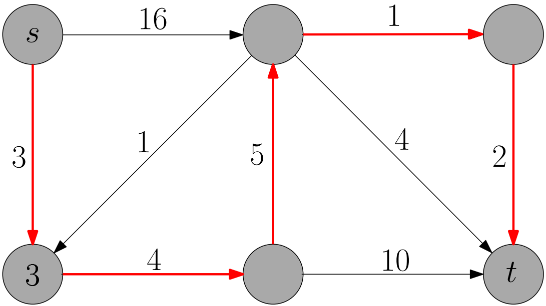

- Algorithm: Dijkstra's algorithm

Algorithm = Computer Program?

- Algorithm: "abstract", can be specified using computer program, English, pseudo-codes or flow charts.
- Computer program: "concrete", implementation of algorithm, using a particular programming language

Pseudo-Code

Pseudo-Code:

Euclidean(a, b)

1: **while** $b > 0$ **do**
2: $(a, b) \leftarrow (b, a \bmod b)$
3: **return** a

Python program:

```
def euclidean(a: int, b: int):
    c = 0
    while b > 0:
        c = b
        b = a % b
        a = c
    return a
```

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4. it is fun!