The Role of Algorithms in Computing

Data structures & algorithms (COSC202A)

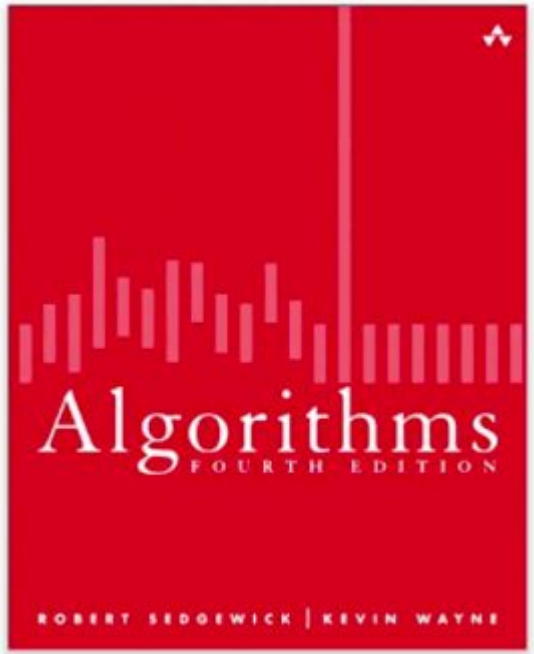
Lecture 1

Logistics

- Email me if you have any questions: rahmed1@colgate.edu
- Course schedule: Thursday 1:20-2:35 pm
- Office hours: Thursday 11:00-12:00 pm
- Email me if you need extra office hours
- Instructor room no.: 313A

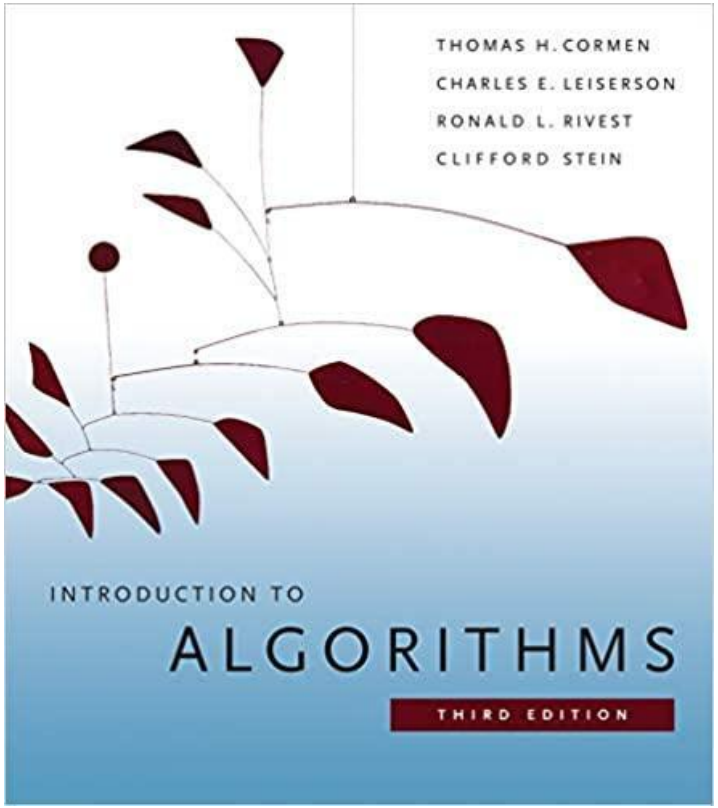
Text book

- Algorithms
- Authors:
  - Robert Sedgewick
  - Kevin Wayne
- Availability: online
- Website: https://algs4.cs.princeton.edu/home/



Another good resource

- Introduction to Algorithms
- Authors:
  - Thomas H. Cormen
  - Charles E. Leiserson
  - Ronald L. Rivest
  - Clifford Stein
- Availability: online



Logistics

- Exams:
  - 45% mark
  - First midterm: Week 5
  - Second midterm: Week 10
  - Final exam
- Online quizzes:
  - 10% mark
  - A set of simple questions after 3-5 lectures
- Homeworks:
  - 45% mark
  - Implementation of lab assignments
  - 10-11 homeworks, 5% mark each, will count best 9

Logistics

Week	Topic
1	Intro
2	Basic data structures
3	Sorting
4	Divide and conquer
5	Binary search tree

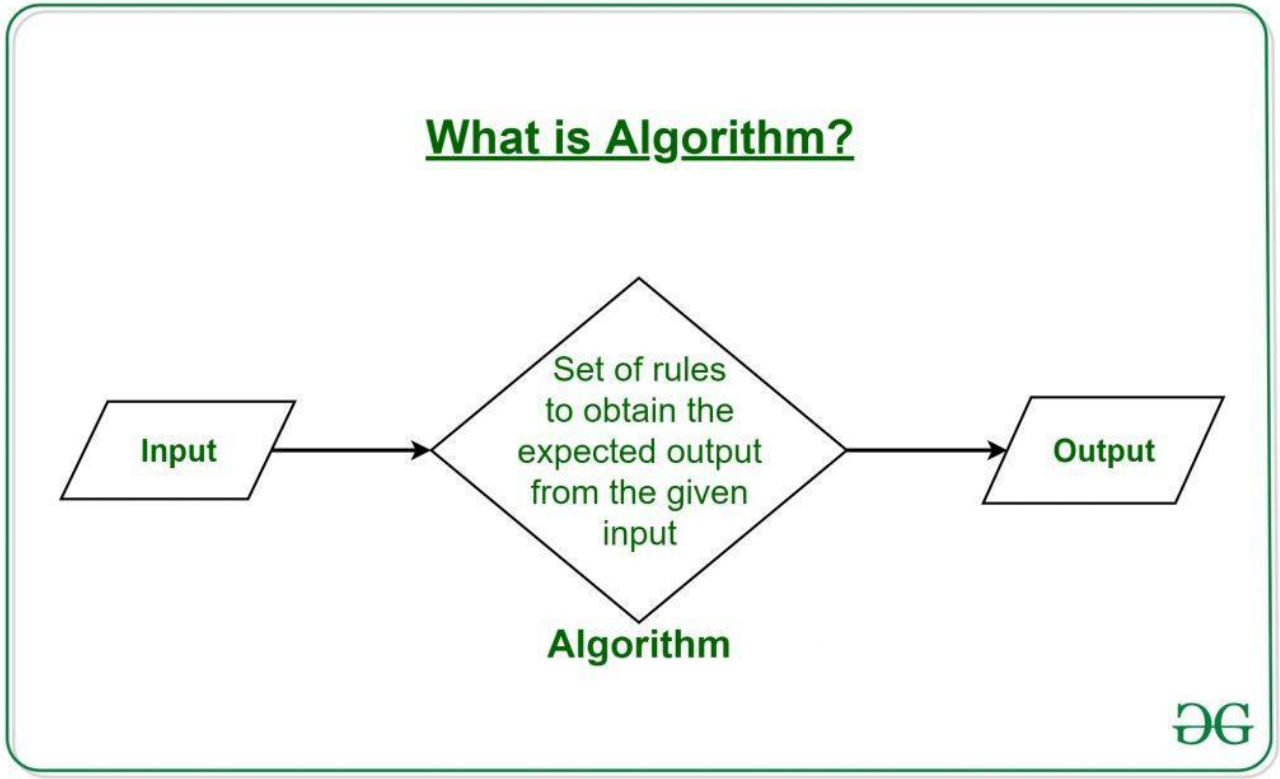
Logistics

Week	Topic
6	Tries (data structure for string operation)
7	Priority queue/heaps
8	Graphs, searching in graphs
9	Application of graph search
10	SP, MST, UF

Logistics

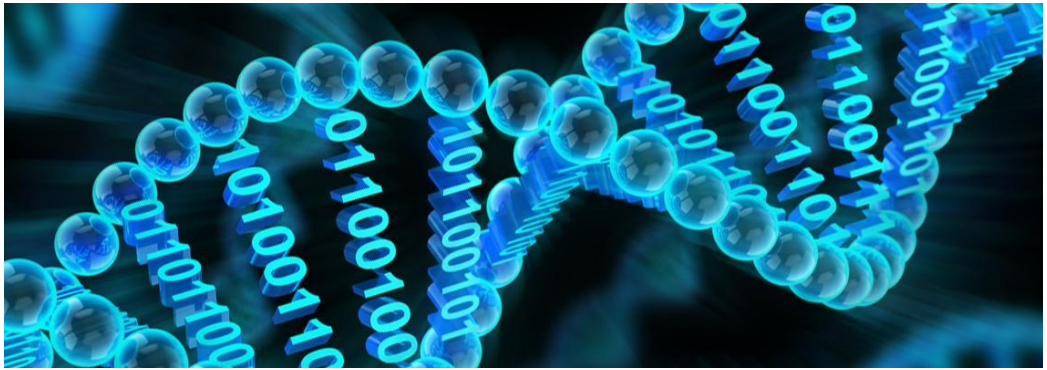
Week	Topic
11	Max flow
12	Greedy algorithms
13	Dynamic programming
14	NP-completeness/reductions

Algorithm


What is Algorithm?
Input
Set of rules to obtain the expected output from the given input
Output
Algorithm

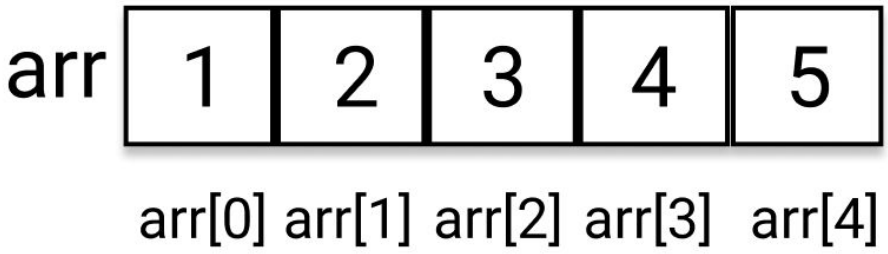
Application

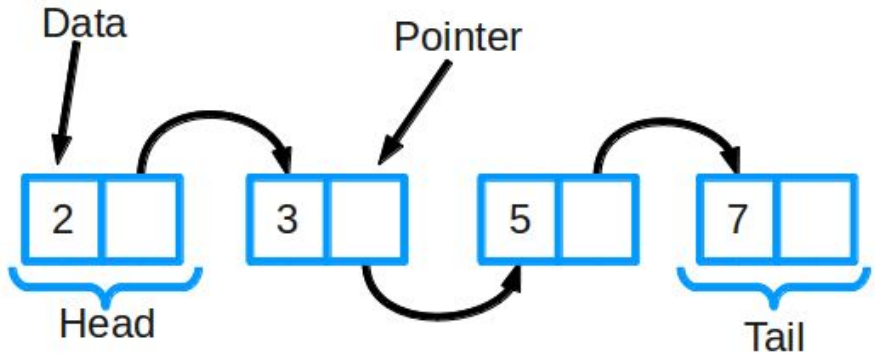
- Bioinformatics
- Information technology
- E-commerce
- …
- Application in everywhere



Data structure

- Information access
- Modification
- Some common data structures:
  - Array
  - Link list
  - ...



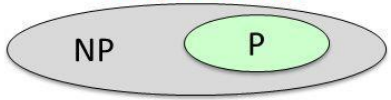


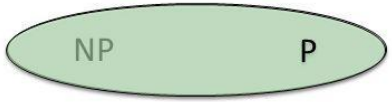
Problem classification

P vs. NP

- P is definitely subset of NP
  - Every problem with poly-time solution is verifiable in poly-time
- Is it proper subset or equal?
  - No one knows the answer

Most guesses are leaning towards P ≠ NP

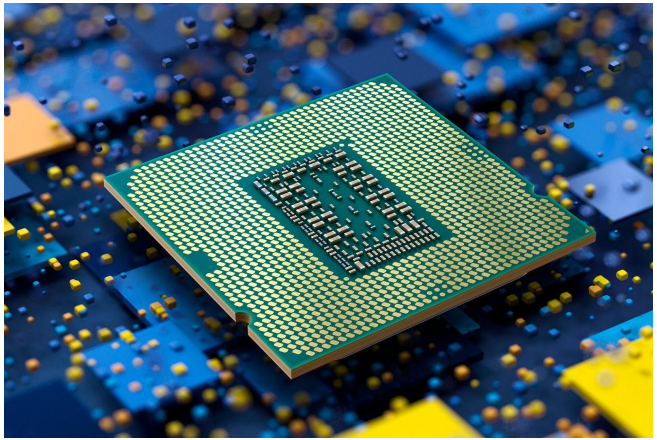




- NP family has set of problems known as "NP-Complete"
  - Hardest problems in NP
  - No poly-time solution for NP-Complete problems yet

Efficiency

- Efficiency in terms of what?
  - Number of computation
  - Memory usage



Efficiency

- How many operations?
- Compute # operations in terms of the size of problem
- Is # operations proportional to problem size?
  - Then it is O(n) (say order n)
- We will discuss more about order notation in future.