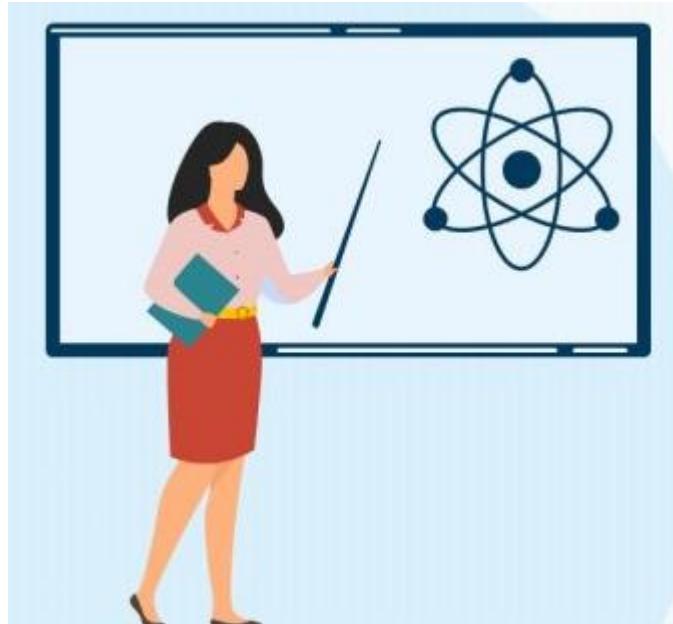


Introduction to Algorithm

EC2206



Welcome

2024.8

Instructor

Suman Pandey



Conduct – Online

Email – suman17july@gmail.com, suman@postech.ac.kr

Office – EECS C3, C wing, 205 room

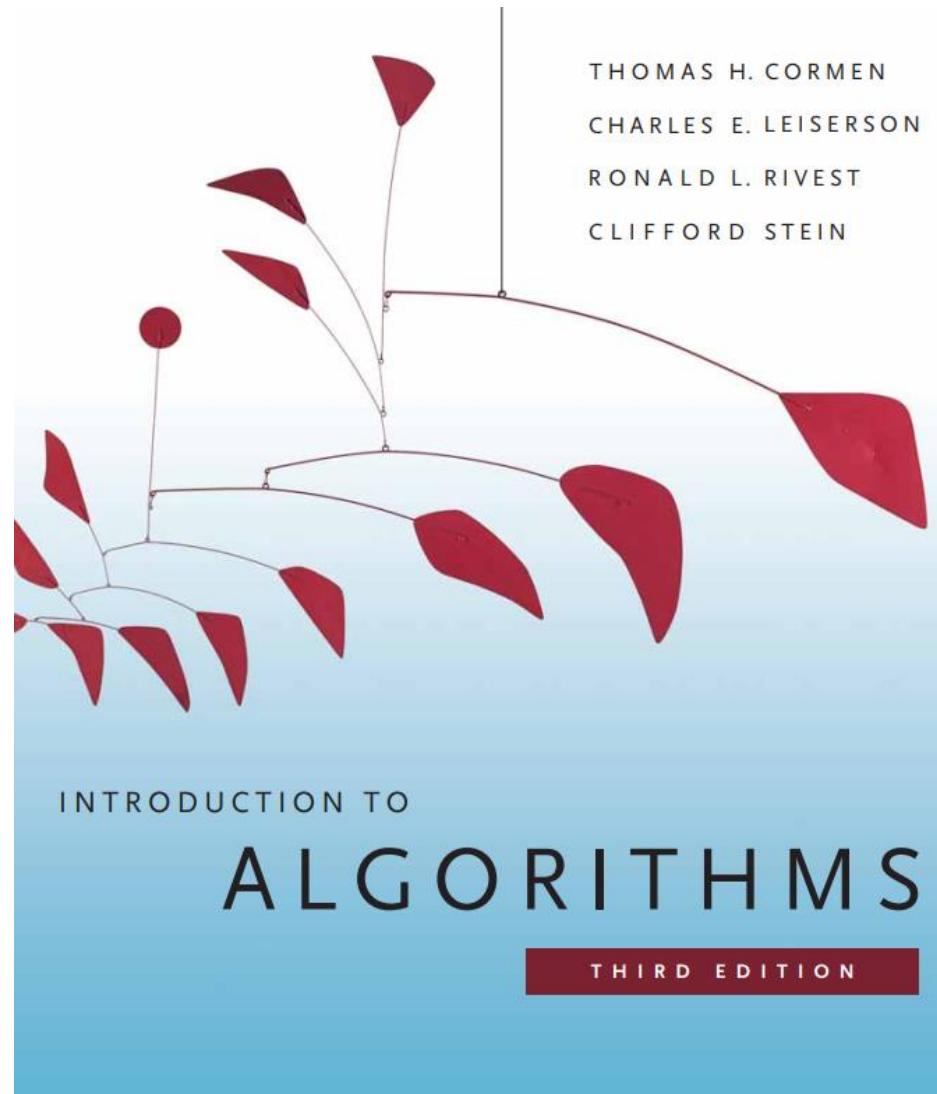
Phone – 010-3742-1791

Technical Assistant

Fullscreen	Email address	Mobile phone
Seunghyuck Hyun	hyun_sh_ug@gm.gist.ac.kr	010-3156-5525
Lim, Chaehyun (임채현)	bkindtoevery1@gm.gist.ac.kr	010-4386-0909
Lee, Jae hee (이재희)	jhlee.ug@gm.gist.ac.kr	010-9177-0913
Altynbek kyzy, Sumaiia	sumaiiaaltyn@gm.gist.ac.kr	010-5083-8220

- ▶ **Assignments and Grading** – Technical Assistants will be responsible to clarify your doubts about Assignments and Grading

Book



Python Basics

▶ https://www.w3schools.com/python/python_intro.asp

The screenshot shows the w3schools website for Python introduction. The URL in the address bar is https://www.w3schools.com/python/python_intro.asp. The page features a navigation bar with links for Tutorials, Exercises, Get Certified, and Services. Below the navigation bar is a secondary menu with links for HTML, CSS, JAVASCRIPT, SQL, PYTHON (which is highlighted in green), JAVA, PHP, HOW TO, W3.CSS, C, C++, C#, BOOTSTRAP, REACT, and MY. On the left side, there is a sidebar with a tree-like navigation structure under "Python Tutorial". The "Python Intro" link is also highlighted in green. The main content area has a Microsoft Azure advertisement with Korean text: "코딩, 테스트, 구축. 지속적으로 새로운 기술을 배우고 Azure를 체험해보세요." Below the ad, the title "Python Introduction" is displayed in large, bold letters. A "Previous" button is located just below the title. The main text section starts with "What is Python?" followed by a paragraph about its history and creator. It then lists what Python is used for, such as web development, software development, mathematics, and system scripting. Another section, "What can Python do?", lists its capabilities like creating web applications, workflows, and connecting to database systems.

w3schools.com/python/python_intro.asp

Python Tutorial

Python HOME

Python Intro

Python Get Started

Python Syntax

Python Comments

Python Variables

Python Data Types

Python Numbers

Python Casting

Python Strings

Python Booleans

Python Operators

Python Lists

Python Tuples

Python Sets

Python Dictionaries

Python If...Else

Python While Loops

Python For Loops

Python Functions

Python Lambda

Python Arrays

Python Classes/Objects

Microsoft Azure

코딩, 테스트, 구축.
지속적으로 새로운 기술을 배우고 Azure를 체험해보세요.

Python Introduction

◀ Previous

What is Python?

Python is a popular programming language. It was created by Guido van Rossum, and released in 1991.

It is used for:

- web development (server-side),
- software development,
- mathematics,
- system scripting.

What can Python do?

- Python can be used on a server to create web applications.
- Python can be used alongside software to create workflows.
- Python can connect to database systems. It can also read and modify files.

Why use Python for Algorithm



- ▶ Once you learn AL, you can proceed with AI easily using python

Python Installation

▶ Install Anaconda

- <https://docs.anaconda.com/anaconda/user-guide/getting-started/#nav-hello>
- Use Jupiter notebook to write your code

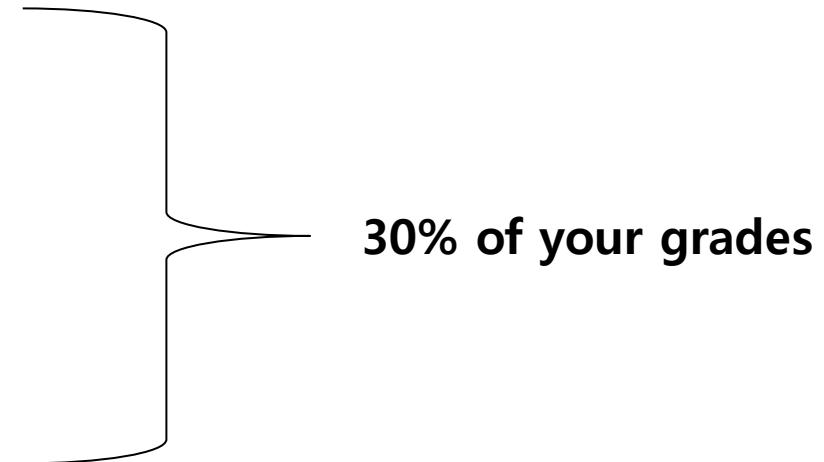
Agenda

- ▶ Role of Algorithms
- ▶ Big O
- ▶ Recursion, Divide and Conquer
- ▶ Sorting Algorithms
- ▶ Dynamic Programming
- ▶ Matrix-Chain multiplication
- ▶ Greedy Algorithm
- ▶ **Mid Term**
- ▶ Binary Trees / Heap
- ▶ Graph
- ▶ Minimum Spanning Tree
- ▶ Shortest Path / Topological Sort
- ▶ **Final Term**
- ▶ **If we have time**
- ▶ Integer Linear Programming
- ▶ NP-Completeness

How Much Coding you will do ?

► **Assignment** - There will be several coding assignments during this course

- Basic Python Skills – 5 question (easy)
- Sorting – 2 questions (easy)
- Recursion – 2 question (medium)
- Dynamic Programming – 3 questions (easy , medium, hard)
- Greedy – 2 question (easy, medium)
- Graph – 2 question (medium, hard)



► **Complexity of Assignment** -

- Easy
- Medium
- Hard

► **Queries related to coding should be directed to Technical Assistants**

► **I will show you sample code for algorithms as we go through each of them.**

Method for Assignment Submission

- ▶ Auto graded challenges – Through out the course 10 different challenges
- ▶ Tool used – Coderbyte.com
- ▶ The tool will auto grade your submission
- ▶ However, TAs, will make sure if the submitted assignment has best time complexity

Assignment Format

- ▶ You will receive an email for each assignment.
- ▶ Open this assignment, when you have enough time and energy to solve the challenge. Going back and forth with these assignment is not possible.

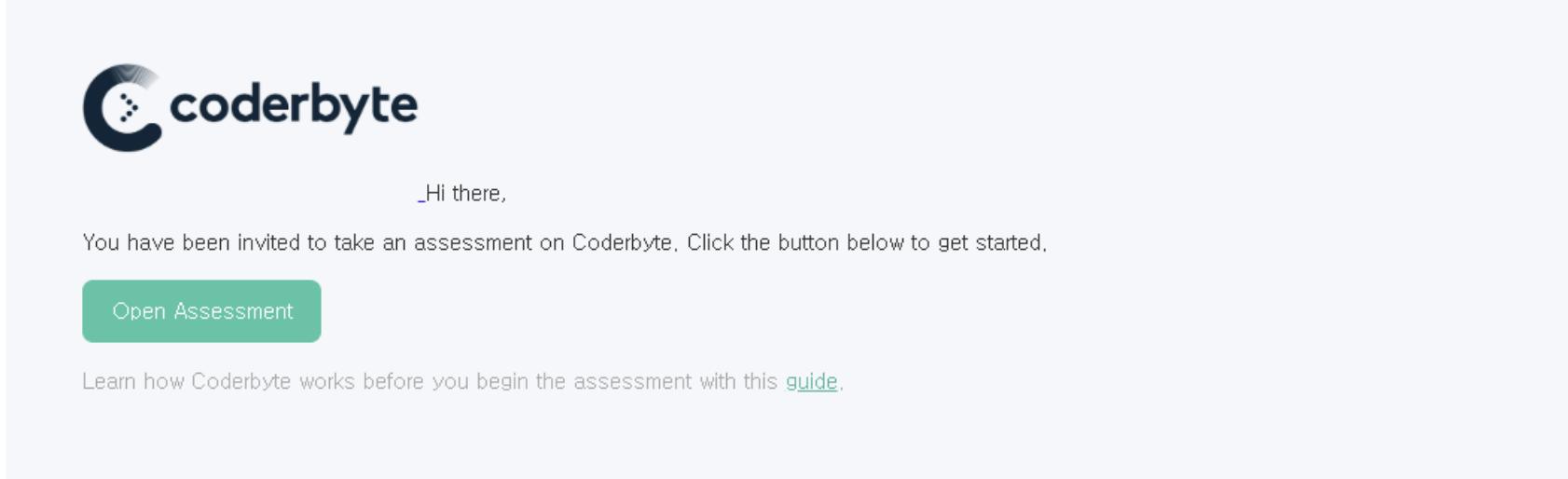
★ Assessment from Gwangju Institute of Science and Technology

From: Coderbyte <do-not-reply@coderbyte.com> Add Block

To :  <suman17@gist.ac.kr> Add

Sent time: 2023.08.25 15:40:35

Secure level  1 | 2 | **3** | 4 | 5 | Compose a mail to the appropriate body



The screenshot shows an email from Coderbyte. The subject is "Assessment from Gwangju Institute of Science and Technology". The email is from "Coderbyte <do-not-reply@coderbyte.com>" and sent to "suman17@gist.ac.kr" at 2023.08.25 15:40:35. The secure level is set to 3. Below the email details, there is a Coderbyte logo and a message: "Hi there, You have been invited to take an assessment on Coderbyte. Click the button below to get started." A green button labeled "Open Assessment" is visible. At the bottom, it says "Learn how Coderbyte works before you begin the assessment with this [guide](#)".

Please Enter Student ID here

- ▶ Enter Student ID, Do not change the default email address.

coderbyte.com/sl-candidate?inviteKey=Foy1zlA1Zb

Student ID

Suman

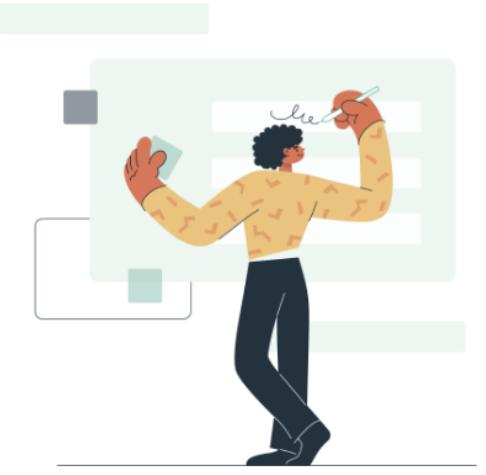
suman17@gist.ac.kr

I understand that once I begin this assessment I cannot leave and return to this assessment at a later time.

Begin Assessment Time limit: Unlimited time

This organization has agreed to the [terms](#) with Coderbyte. Learn more about how your data is stored in our [privacy policy](#).

Gwangju Institute of Science and Technology
Assessment



✓ Learn how Coderbyte works before you begin the assessment

Begin Submitting Assignment

- ▶ Begin the assignment, Mostly you will get entire weekend to solve your assignment. Unless I take a mock test, where I can limit the time.

The screenshot shows a web browser window with the URL coderbyte.com/candidate-assessment. The page is titled "Gwangju Institute of Science and Technology Assessment". On the left, the Coderbyte logo is displayed with the text "TIME LIMIT" above "Unlimited time". The main content area contains a welcome message: "Welcome to your Coderbyte assessment. Try and solve the challenges and answer the questions within this assessment to the best of your ability. Good luck!" Below this is a green button labeled "Begin Assessment". A note at the bottom states: "Once you begin this assessment you will need to complete all of the challenges and answer all of the questions within the time limit." The browser's address bar and various icons are visible at the top.

Click on Begin Challenge

- ▶ Click on Begin Challenge.

The screenshot shows a web browser window for the Coderbyte candidate assessment at coderbyte.com/candidate-assessment. The page has a light gray header with navigation icons and a URL bar. The main content area is divided into sections: 'Assessment' (with 'TIME LEFT' showing 'Unlimited time'), 'CODY BYTES' (with 'Gwangju Institute of Science and Technology' and a scroll bar), and 'Coding Challenges' (listing three challenges: 'First Factorial', 'Array Addition I', and 'sum of two numbers', each with a 'Begin Challenge' button). A large green 'Submit Assessment' button is at the bottom left. At the bottom, there are links for 'CHALLENGES' and 'INCOMPLETE'.

Assessment

TIME LEFT
Unlimited time

Gwangju Institute of Science and Technology

Welcome to your Coderbyte assessment.

Submit Assessment

CHALLENGES INCOMPLETE

CODING CHALLENGES

- First Factorial Begin Challenge
- Array Addition I Begin Challenge
- sum of two numbers Begin Challenge

Click on Begin Challenge



[View Assessment](#)

Challenge Information

Difficulty: Easy

Maximum Score: 10

Description: For this challenge you will be determining the factorial for a given number.

BEGIN CHALLENGE →

We run a script that is only activated on the editor page which will save your mouse movements and key presses. This allows your organization to see how you modify your code over time. The tracking is only performed on the next web page, so it will not occur on any other web page or website once you leave Coderbyte. For more information on how this works email us at support@coderbyte.com

Write your code, test your code and submit



[← Back to assessment](#) | [View instructions](#)

easy

Time left: Unlimited time

Python3

Vim

Emacs

Light

Reset

▶ Run Code

▶ Run Test Cases

Submit

8

Auto-clear Clear log

Python version: 3.9.17

Packages installed

approvaltests
boto3
mysql
numpy
pandas
pyspark
pytest
requests
scikit-learn
scipy
tensorflow
tqdm
unittest

Output logs will appear here

- ▶ Read and solve your challenge.
- ▶ You can run code, and provide input in the text box
- ▶ You can run all the test cases, at once, it will indicate if any test case is failing
- ▶ Fix your code and run it as many times as you like before clicking submit button

First Factorial

Have the function `FirstFactorial(num)` take the `num` parameter being passed and return the factorial of it. For example: if `num = 4`, then your program should return $(4 * 3 * 2 * 1) = 24$. For the test cases, the range will be between 1 and 18 and the input will always be an integer.

Examples

Input: 4
Output: 24

Input: 8
Output: 40320

Browse Resources

powered by Google

Search for any help or documentation you might need for this problem. For example: array indexing, Ruby hash tables, etc.



After completing all the challenge Submit Assignment

- ▶ After finishing all the assignment, you can click on Sumit Assignment

The screenshot shows the Coderbyte assessment interface. On the left, there's a sidebar with the Coderbyte logo, a "TIME LEFT" section indicating "viewing as admin", the institution "Gwangju Institute of Science and Technology", a welcome message, and a "Submit Assessment" button. The main area is titled "Assessment" and contains a "CODING CHALLENGES" section. It lists three challenges: "First Factorial", "Array Addition I", and "sum of two numbers", each marked as "✓ Completed".

Challenge	Status
First Factorial	✓ Completed
Array Addition I	✓ Completed
sum of two numbers	✓ Completed

Professors Dashboard looks like this

Python Assessment

[Preview](#) [Edit](#)

Created by pawantiwari@bitmesra.ac.in on Jul 05 2023

Invite candidates

(4/300 max) [?](#)

john@email.com, sarah@email.com, ... (up to 50 email addresses)

[Send private invite link](#)

OR

[Copy public invite link](#)

Assessment details

3

Challenges

0

Open-ended

0

Multiple choice

Candidate details

25%

Qualifying

- 4 invited
- 3 assessed
- 1 qualified

All candidates

[JSON Export](#)

[CSV Export](#)

Search for candidates...

Name	Email	Status	Joined	Time Taken	Final score	Cheating	Actions
20210234	suman17@gist.ac.kr	In progress	Aug 25	N/A	0%	Not detected	View report
suman	suman17july@gmail.com	Submitted	Jul 06	N/A	83%	Not detected	View report
-	pawantiwari@bitmesra.ac.in	Submitted	Jul 05	N/A	67%	Detected	View report
-	suman17@gist.ac.kr	Invited (Aug 25)	-	N/A	N/A	N/A	

Grading

- ▶ **Assignment – 30%**
- ▶ **Mid Term – 30%**
- ▶ **Final Term – 30%**
- ▶ **Class presence – 10%**

Teaching Methodology

“First, solve the problem.
Then, **write the code**”.

- John Johnson

- ▶ I will first explain the algorithm, and then show you code
- ▶ There are two approach to this class
 - Mathematical
 - Coding
- ▶ Mathematical approach is great for writing paper and research articles
- ▶ Coding approach is better for preparing you for interview with big companies
- ▶ We will discuss both the approaches

Attendance

Attendance will be taken in Google form. Please fill your Student ID carefully. Password for the attendance will be announced in the class.

► [Algorithm Mon-Wed \(google.com\)](#)

► [Algorithm Tue-Thurs \(google.com\)](#)

The screenshot shows a Google Form titled "Algorithm Tue-Thurs". At the top, it displays the email address "suman17july@gmail.com" and a "Switch account" link, along with a cloud icon indicating it's a shared form. Below this, a note states "* Indicates required question". The form contains two required fields: "Student ID *" and "Password *". Each field has a text input area labeled "Your answer". At the bottom right of the form, there are "Submit" and "Clear form" buttons.

Algorithm Tue-Thurs

suman17july@gmail.com [Switch account](#)

Not shared

* Indicates required question

Student ID *

Your answer

Password *

Your answer

[Submit](#) [Clear form](#)

Expectation from Students



Spoon feeding
teaches us nothing,
except the
shape of the spoon.

► Code Practice

- You should practice all the algorithm explained in the class by yourself, in order to do the assignment well
- There wont be any Spoon Feeding.
- Assignments will be re-evaluated by TA. Don't make their life hard. Do as expected.
- Copying code is not allowed, the tool comes with plagiarism checker, A very heave –ve penalty will be given to your if caught

What is Algorithm?

It's a set of **computational steps**, that transforms **input** to **output**.

Algorithm should have
Definiteness, Finiteness,
Effectiveness

What kind of problems are solved using Algorithms

► Human Genome Project

- **Given two sequence of symbols, find longest common subsequence (Matching two DNA stands)**

► Internet

- **Routing Algorithms**
- **Search engines**

► Commerce

- **Public-key cryptography**
- **Digital signature generations**

► Maximizing profit

- **Oil company- Where to put well to maximize profit**
- **Election candidate – where to campaign to win election**
- **Airlines – assign crew to flights in least expensive ways**
- **ISP – where to install 5G devices to provide best quality to mobile users**

Difference between Data Structure and Algorithm

► Data Structure

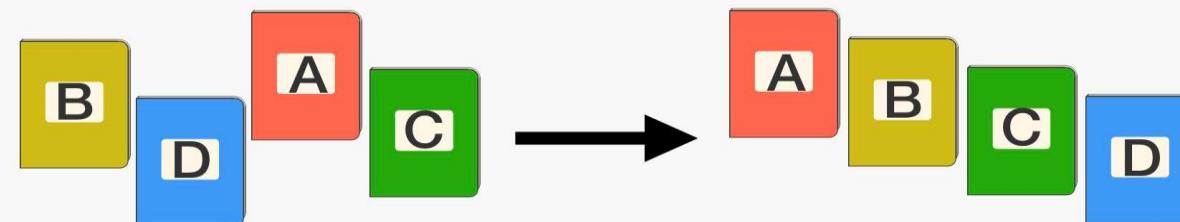
- **It's a way to organize and store data.**
- **No Single data structure works well for all purposes.**
- **Its important to know the strength and limitations of several of them**
- **Ex – Arrays, Lists, Tree, Graph, Stack, Queues, Hash tables, Maps**

► Algorithms

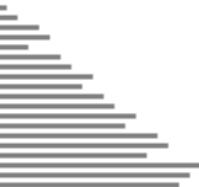
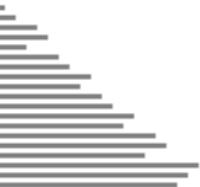
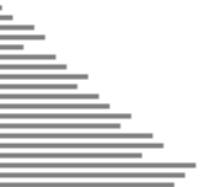
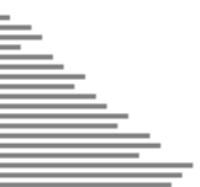
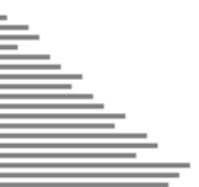
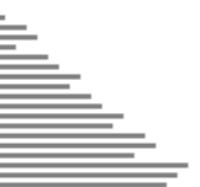
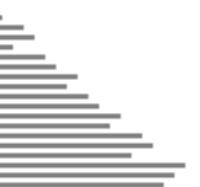
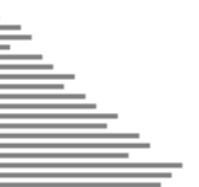
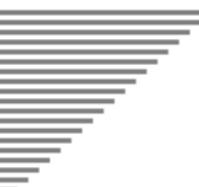
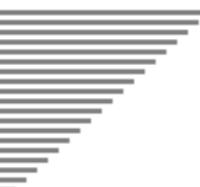
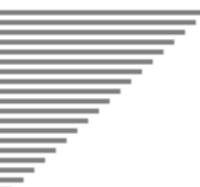
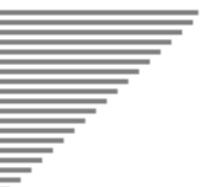
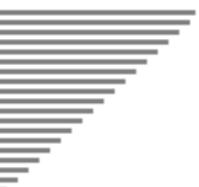
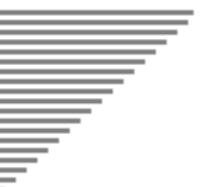
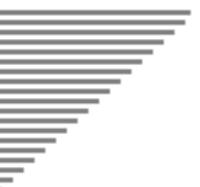
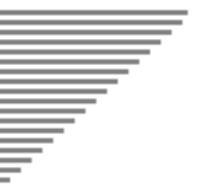
- **Step by step procedure for performing a task.**
- **Specific data structure can help design a good algorithm to solve the problem**
- **Data structure is pre-requisite for Algorithm course**

Lets Start

Sorting Algorithms



Types of Sorting Algorithm

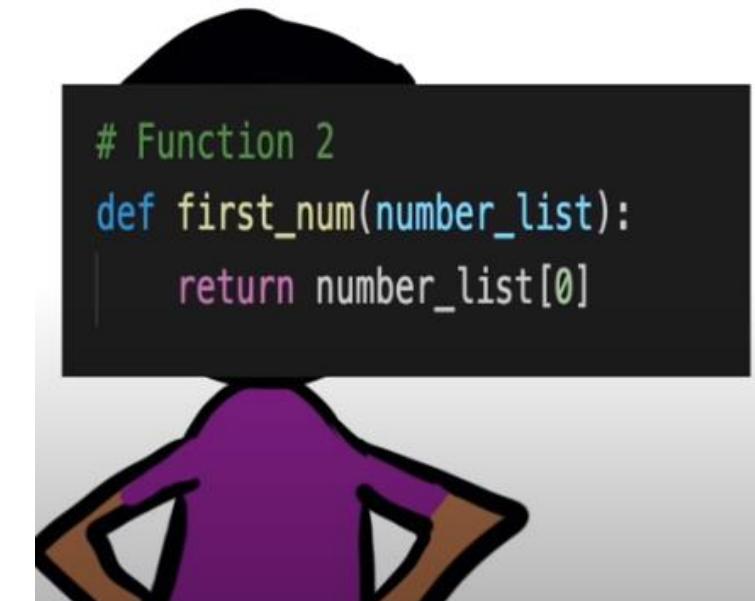
	 Insertion	 Selection	 Bubble	 Shell	 Merge	 Heap	 Quick	 Quick3
 Random								
 Nearly Sorted								
 Reversed								
 Few Unique								

► Criteria to **test** an algorithm - No of Operations. – **Big O** notation

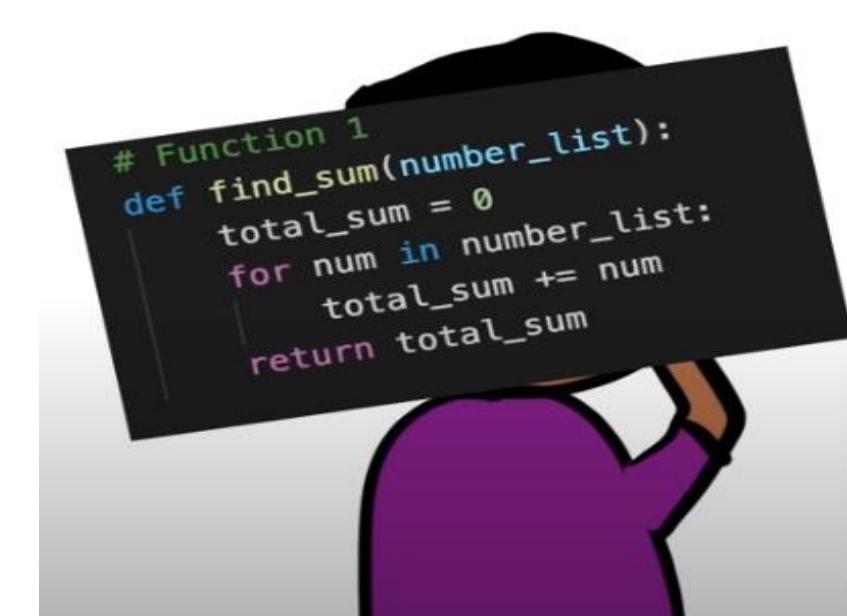
Big 0

► Big 0 Notation

- A mathematical notation used to classify algorithms according to how their **run time** or space requirements grow **as the input size grows.**



- 1 Operation - **O(1)**

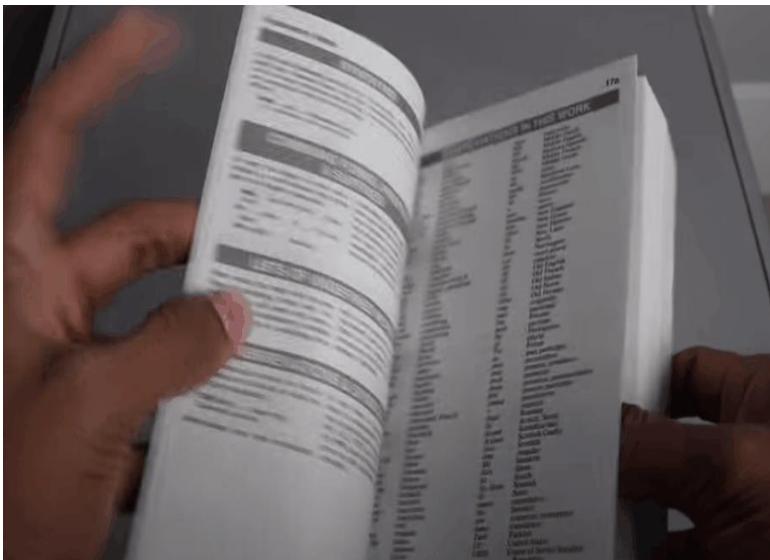


- n Operation - **O(n)**

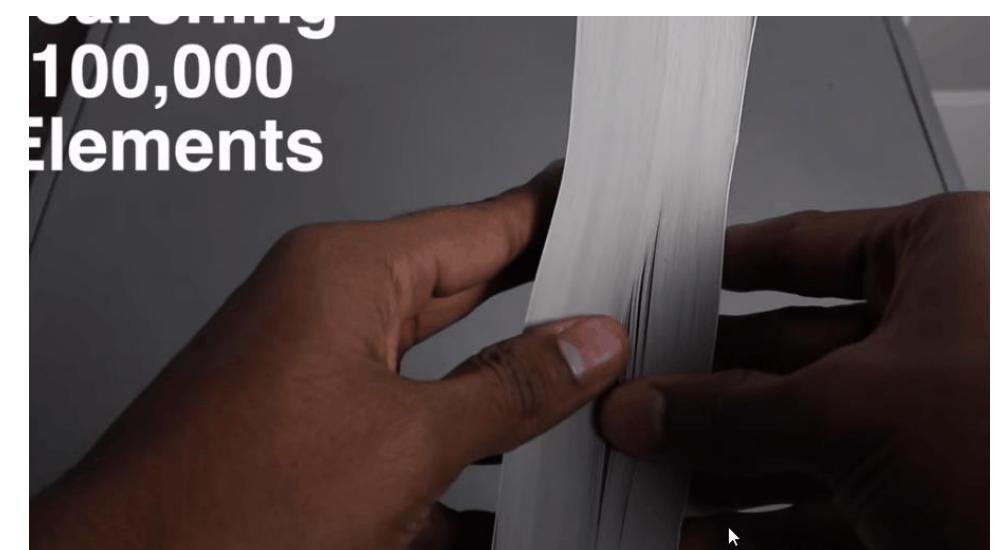
Big O Searching Dictionary

► Big O Notation

Sequential Search



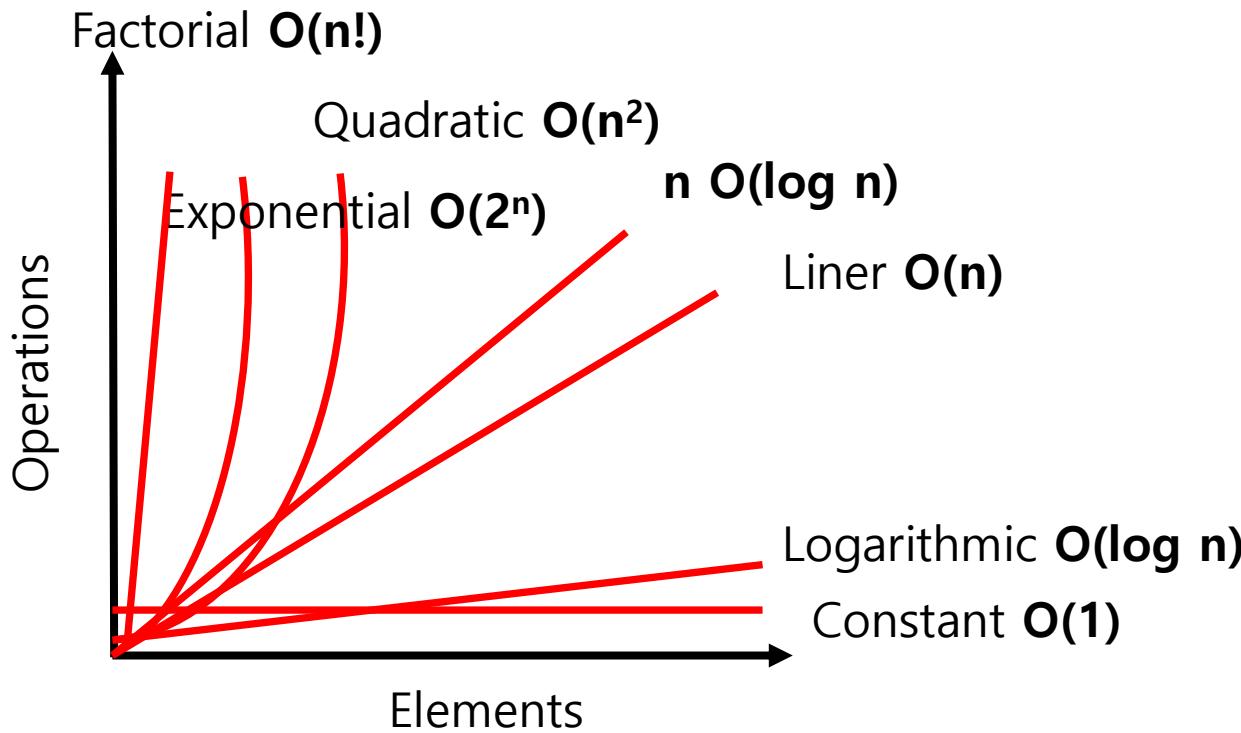
Binary Search



- 1 Operation - **O(n)**

- n Operation - **O(log n)**

Time Complexities of Big O

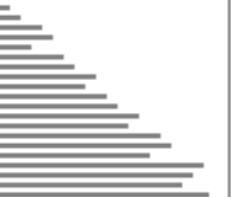
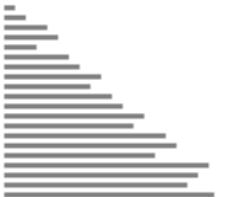
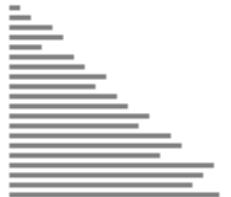
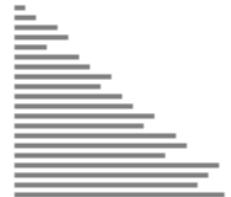
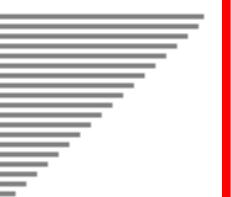
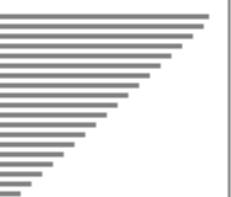
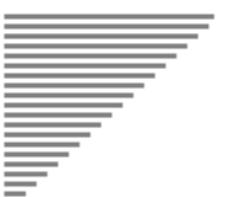
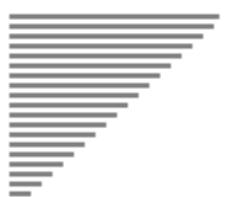
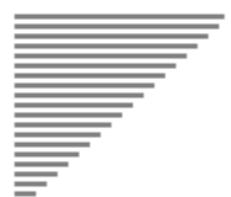
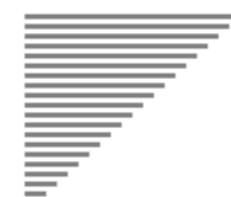


N: 17

$O(1):$	1
$O(\log N):$	4
$O(N):$	17
$O(N^2):$	289
$O(2^N):$	131072
$O(N!):$	3556874280960



Types of Sorting Algorithm

	 Insertion	 Selection	 Bubble	 Shell	 Merge	 Heap	 Quick	 Quick3
								
								
								
								

► Criteria to **test** an algorithm - No of Operations. – **Big O** notation