

IT5003 Mar-May 2024  
Data Structures and Algorithms

**Tutorial+Lab 02**  
**Sorting**

Document is last modified on: January 5, 2024

## 1 Introduction and Objective

Today, we will discuss various Sorting algorithms and the many various applications that are possible after we sort our list.

You are encouraged to review e-Lecture of <https://visualgo.net/en/sorting?slide=1> to the last slide 19-5, but skipping Slide 16 to 16-2 (Radix Sort) to save a bit of time (Radix Sort and a few other details of other sorting algorithms are discussed in harder algorithm courses).

## 2 Questions

### Sorting, Applications

Q1). At <https://visualgo.net/en/sorting?slide=1-2>, Prof Halim mentions a few (not exhaustive) array (or list) applications that become easier/more efficient if the underlying array is sorted. Now, we will quickly discuss application *a few* of these application 1-7 in algorithmic level only.

### Sorting, Mini Experiment

Q2). Please use the 'Exploration Mode' of <https://visualgo.net/en/sorting> to complete the following table. You can use 'Create' menu to create input array of various types. You will need to fully understand the individual strengths and weaknesses of each sorting algorithms discussed in class in order to be able to complete this mini experiment properly.

For example, on random input, Optimized (Opt) Bubble Sort that stops as soon as there is no more swap inside the inner loop runs in  $O(N^2)$  but if we are given an non-decreasing numbers as input, that Optimized Bubble Sort can terminate very fast, i.e., in  $O(N)$ .

Note that N-d and N-i means Non-decreasing (increasing or equal) and Non-increasing (decreasing or equal), respectively.

Note that Many Duplicates include All Equal test cases.

Note also that the term ‘Nearly sorted’ can have multiple definitions and we will discuss this in class.

Input type → ↓ Algorithm	Random	Sorted		Nearly Sorted		Many Duplicates
		N-d	N-i	N-d	N-i	
(Opt) Bubble Sort	$O(N^2)$	$O(N)$				
(Min) Selection Sort					$O(N^2)$	
Insertion Sort		$O(N)$				
Merge Sort	$O(N \log N)$			$O(N \log N)$		
Quick Sort		$O(N^2)$				
(Rand) Quick Sort						$O(N \log N)$
Counting Sort					$O(N)$	

## Hands-on 2

TA will run the second half of this session with a few to do list:

- PS1 Quick Debrief,
- Do a sample speed run of VisuAlgo online quiz that are applicable so far, e.g., <https://visualgo.net/training?diff=Medium&n=5&t1=5&module=sorting>.
- Finally, live solve a chosen Kattis problems involving sorting.

## Problem Set 2

We will end the tutorial with high level discussion of PS2 A+B.