# DATA STRUCTURE AND ALGORITHM

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# Overview

- Concept of sorting
- Types of sorting: internal and external
- Sorting algorithm: selection,  insertion and bubble
- Divide and conquer algorithm : merge sorting

# Objectives

- Understanding sorting algorithm
- To learn how to use sorting techniques

# sorting

- Sorting refers to arranging data in a particular format. Sorting algorithm specifies the way to arrange data in a particular order. Most common orders are in numerical or lexicographical order.
- A sorting algorithm is just a series of orders or instructions. In this, an array is an input, on which the sorting algorithm performs operations to give out a sorted array.
- The importance of sorting lies in the fact that data searching can be optimized to a very high level, if data is stored in a sorted manner. Sorting is also used to represent data in more readable formats. Following are some of the examples of sorting in real-life scenarios −
  - **Telephone Directory** − The telephone directory stores the telephone numbers of people sorted by their names, so that the names can be searched easily.
  - **Dictionary** − The dictionary stores words in an alphabetical order so that searching of any word becomes easy.

# Type of sorting

- There are two different categories in sorting:
  - **Internal sorting**: If the input data is such that it can be adjusted in the main memory at once, it is called internal sorting.
  - **External sorting**: If the input data is such that it cannot be adjusted in the memory entirely at once, it needs to be stored in a hard disk, floppy disk, or any other storage device. This is called external sorting.

# Selection Sort

- The selection is a straightforward process of sorting values.
- In this method, to sort the data in ascending order, the $0^{th}$ element is compared with all other elements.
- If the $0^{th}$ element is found to be greater than the compared element, the two values get interchanged.
- In this way after the first iteration, the smallest element is placed at $0^{th}$ position.
- The technique is repeated until the full array gets sorted.

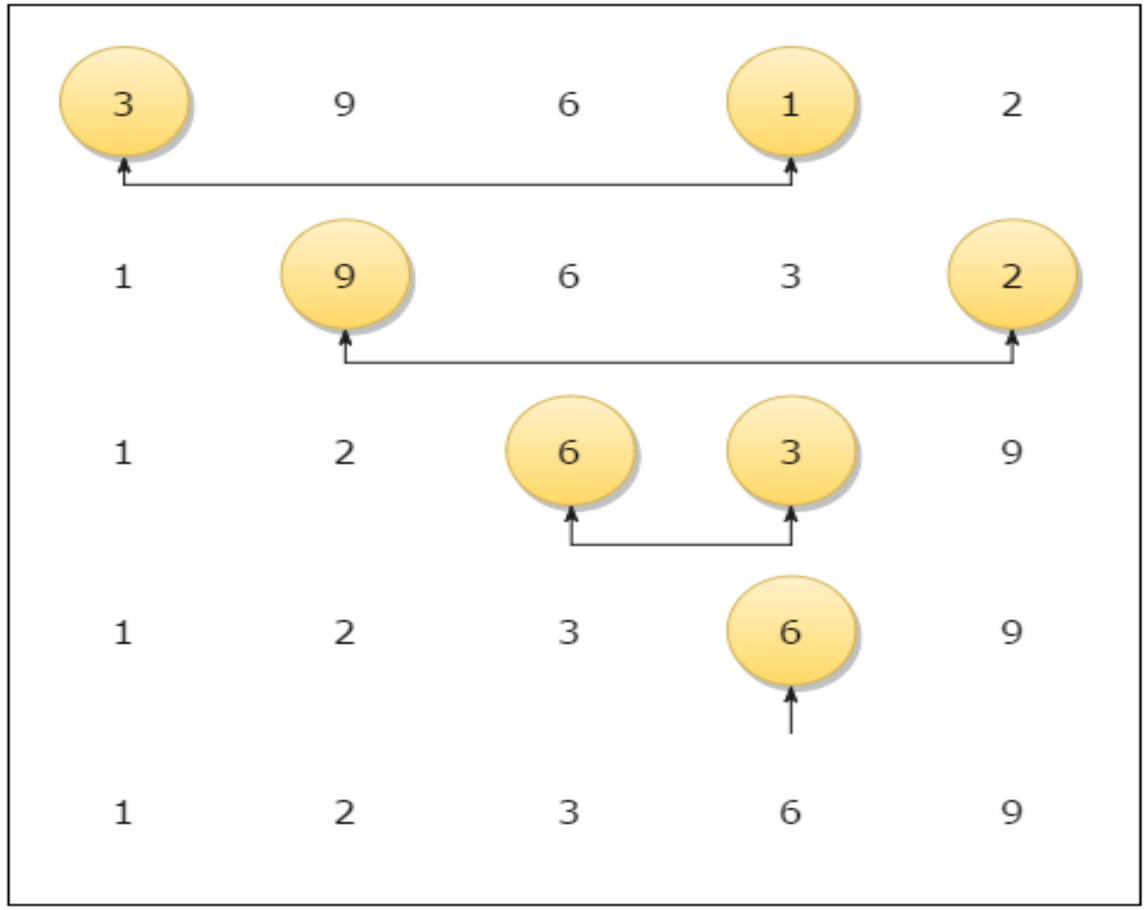



Fig. Selection Sort Technique

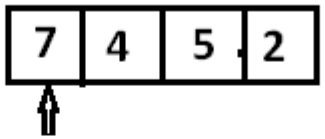
# Insertion Sort

- Insertion sort is a simple sorting algorithm that works similar to the way you sort playing cards in your hands.
- The array is virtually split into a sorted and an unsorted part.
- Values from the unsorted part are picked and placed at the correct position in the sorted part.

Algorithm:

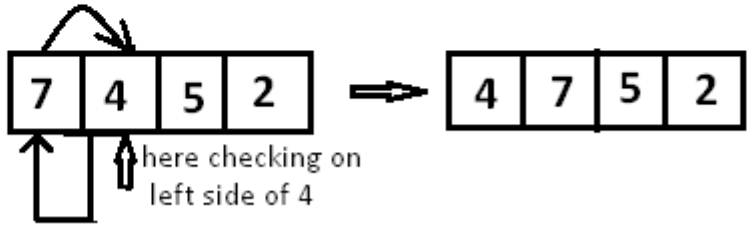
1. If it is the first element, it is already sorted. return 1;
2. Pick next element
3. Compare with all elements in the sorted sub-list
4. Shift all the elements in the sorted sub-list that is greater than the value to be sorted
5. Insert the value
6. Repeat until list is sorted

STEP 1.



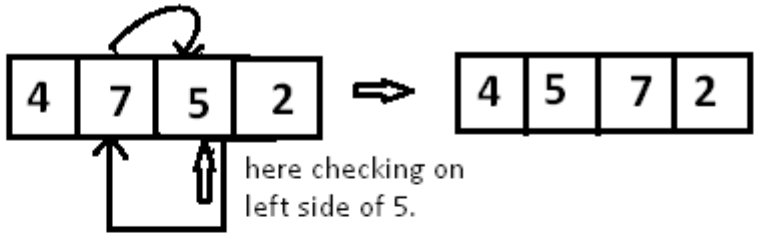

No element on left side of 7,so no change in its position .

STEP 2.



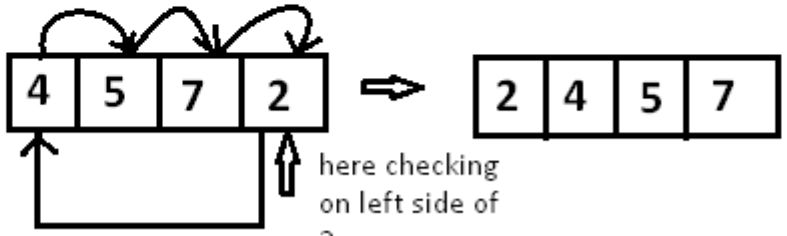

As 7>4 ,therfore 7 will be moved forward and 4 will be moved to 7's position.

STEP 3.




As 7>5,7 will be moved forward,but 4 <5,so no change in position of 4. And 5 will be moved to position of 7.

STEP 4.




As all the element on left side of 2 are greater than 2,so all the elements will be moved forward and 2 will be shifted to position of 4

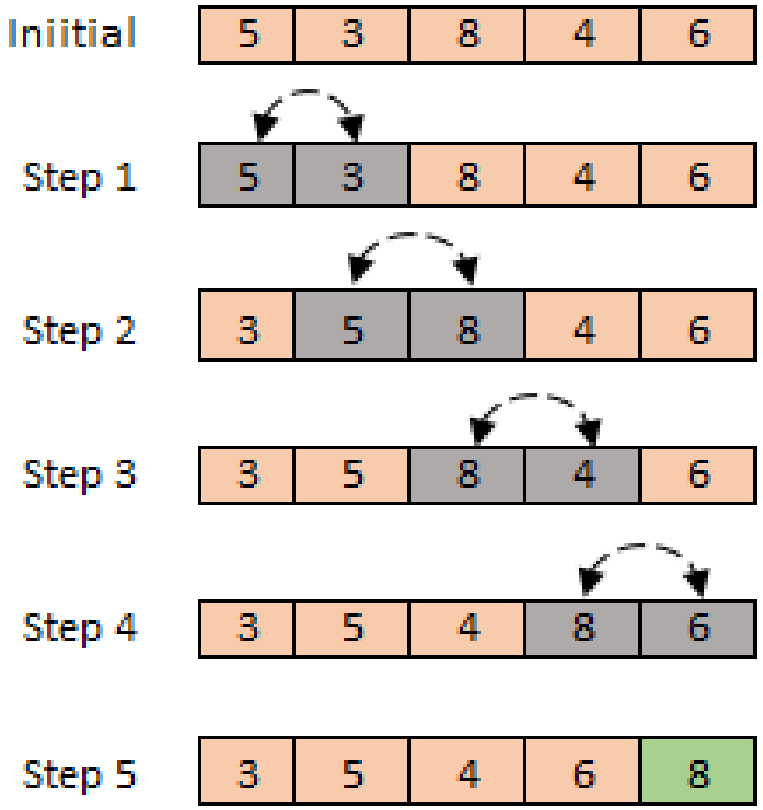
# Bubble Sort

- Bubble sort is a simple sorting algorithm.
- This sorting algorithm is comparison-based algorithm in which each pair of adjacent elements is compared and the elements are swapped if they are not in order.
- This algorithm is not suitable for large data sets as its average and worst case complexity are of $O(n^2)$ where **n** is the number of items.

Algorithm :

1. First iteration(compare and swap)
   - Starting from the first index, compare the first and the second elements.
   - If the first element is greater than the second element, they are swapped.
   - Now, compare the second and the third elements. Swap them if they are not in order.
   - The above process goes on until the last element.
2. Remaining iteration(same process)

## Bubble sort example



# Divide And Conquer Algorithm : Merge Sorting

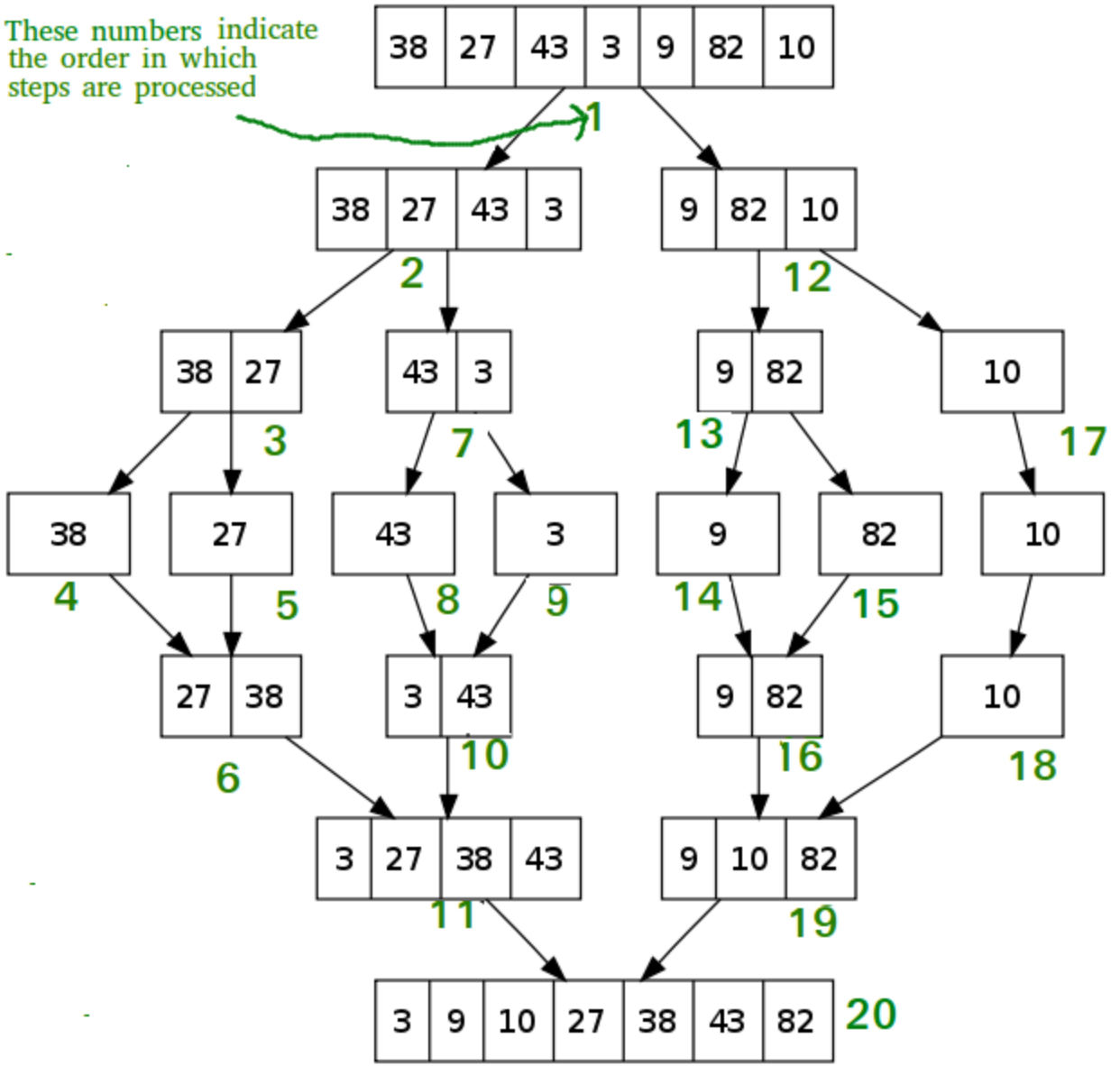
- A **divide and conquer algorithm** is a strategy of solving a large problem by:
  - breaking the problem into smaller sub-problems
  - solving the sub-problems, and
  - combining them to get the desired output.
- The divide-and-conquer technique is the basis of efficient algorithms for many problems, such as sorting (e.g., quicksort, merge sort)

# Merge Sorting

- Merge sort is a sorting technique based on divide and conquer technique. With worst-case time complexity being O(n log n), it is one of the most respected algorithms.
- Merge sort first divides the array into equal halves and then combines them in a sorted manner

Algorithm

- Divide the unsorted list into sub-lists, each containing element.
- Take adjacent pairs of two singleton lists and **merge** them to form a list of 2 elements. N. will now convert into lists of size 2.
- Repeat the process till a single **sorted** list of obtained


These numbers indicate the order in which steps are processed
38 27 43 3 9 82 10
1
38 27 43 3
9 82 10
2
12
38 27
43 3
9 82
10
3
7
13
17
38
27
43
3
9
82
10
4
5
8
9
14
15
27 38
3 43
9 82
10
6
10
16
18
3 27 38 43
9 10 82
11
19
3 9 10 27 38 43 82
20

# Further Readings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