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Department of Multimedia and Gaming
Course: Data Structures CSC-221 (Practical)
Instructor: Engr. Fatima Jaffar

LAB 09

Objective: Understanding and Implementing Binary Search and Bubble sort

1. Binary Search

- Binary Search Algorithm is a searching algorithm used in a sorted array by repeatedly dividing the search interval in half.
- The idea of binary search is to use the information that the array is sorted and reduce the time complexity to O(log N).

Conditions to apply Binary Search Algorithm in a Data Structure

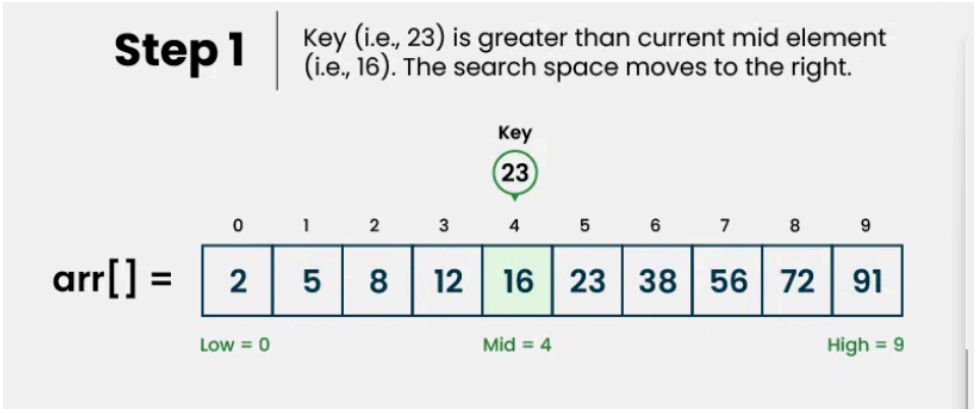
- The data structure must be sorted.
- Access to any element of the data structure should take constant time.

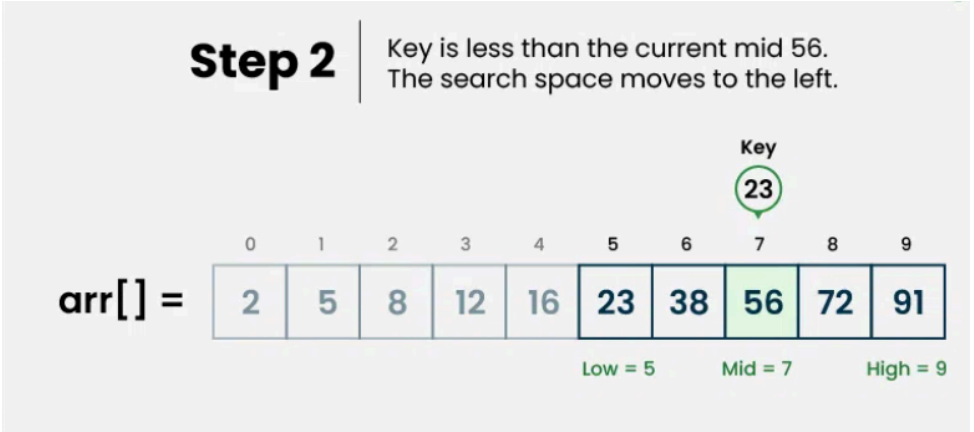
Binary Search Algorithm

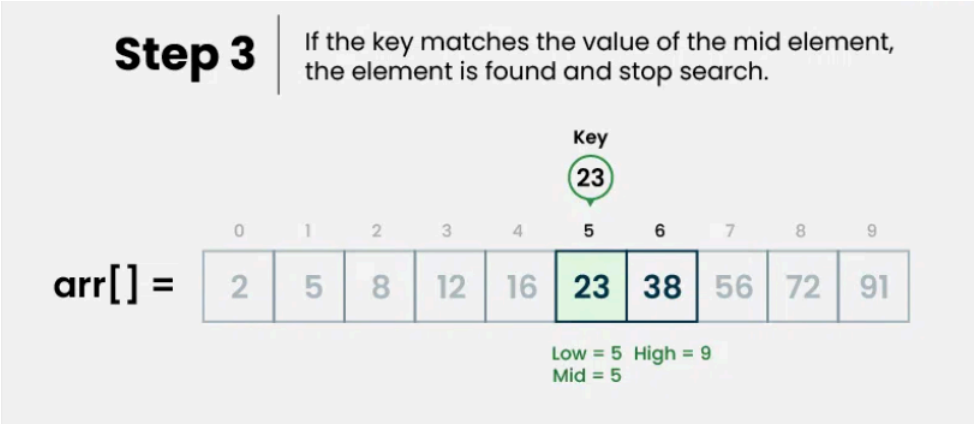
1. Divide the search space into two halves by finding the middle index "mid".
2. Compare the middle element of the search space with the key.
3. If the key is found at middle element, the process is terminated.
4. If the key is not found at middle element, choose which half will be used as the next search space.
5. If the key is smaller than the middle element, then the left side is used for next search.
6. If the key is larger than the middle element, then the right side is used for next search.
7. This process is continued until the key is found or the total search space is exhausted.

How does Binary Search Algorithm work?

Consider an array arr[] = {2, 5, 8, 12, 16, 23, 38, 56, 72, 91}, and the target = 23.





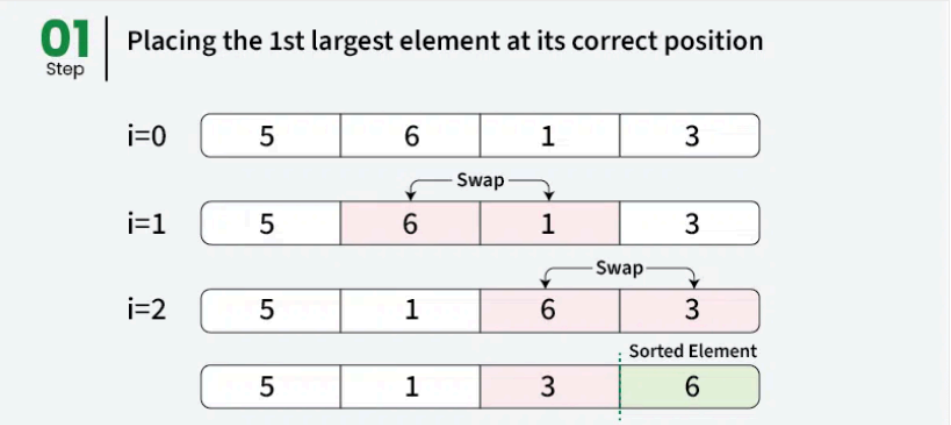


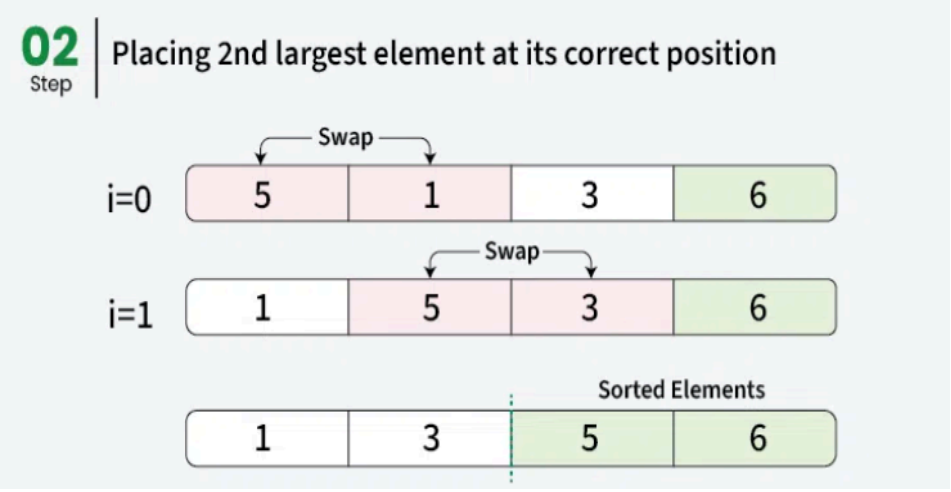
Bubble Sort Algorithm

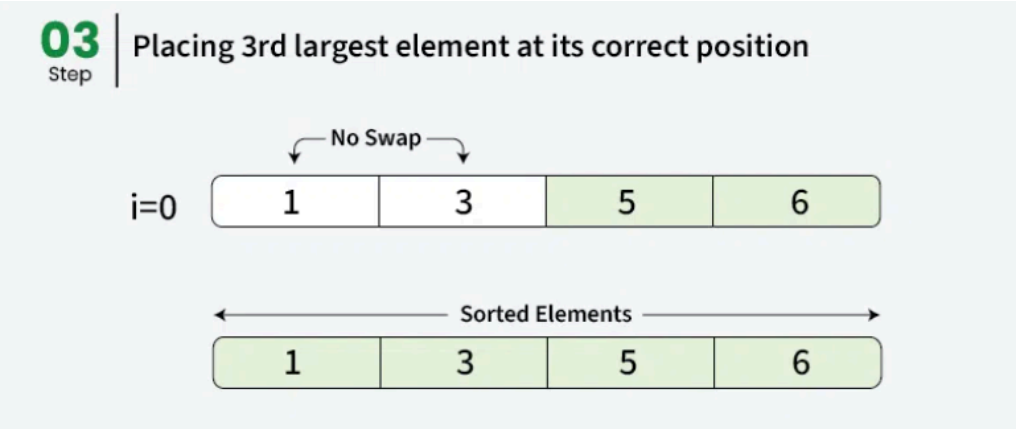
Bubble Sort is the simplest sorting algorithm that works by repeatedly swapping the adjacent elements if they are in the wrong order. This algorithm is not suitable for large data sets as its average and worst-case time complexity are quite high.

- We sort the array using multiple passes. After the first pass, the maximum element goes to end (its correct position). Same way, after second pass, the second largest element goes to second last position and so on.
- In every pass, we process only those elements that have already not moved to correct position. After k passes, the largest k elements must have been moved to the last k positions.
- In a pass, we consider remaining elements and compare all adjacent and swap if larger element is before a smaller element. If we keep doing this, we get the largest (among the remaining elements) at its correct position.

How does Bubble Sort Algorithm work?







Advantages of Bubble Sort:

- Bubble sort is easy to understand and implement.
- It does not require any additional memory space.
- It is a stable sorting algorithm, meaning that elements with the same key value maintain their relative order in the sorted output.

Disadvantages of Bubble Sort:

- Bubble sort has a time complexity of $O(n^2)$ which makes it very slow for large data sets.
- Bubble sort is a comparison-based sorting algorithm, which means that it requires a comparison operator to determine the relative order of elements in the input data set. It can limit the efficiency of the algorithm in certain cases.

LAB TASKS

1. Implement Binary search algorithm using java
2. Implement Bubble sort algorithm using java