EX-1.9

Title :

Check if a given number x exists in a sorted array arr using binary search.

Aim:

To design and implement a Python program to search for a given key in a sorted array using binary search.

Procedure:

1. Read input size n.
2. Read n elements into an array.
3. Read the key to search for.
4. Implement binary search on the sorted array:
    - Initialize `low = 0`, `high = n - 1`.
    - While `low <= high`:
        - Calculate `mid = (low + high) // 2`.
        - If `arr[mid] == key`, return the position.
        - If `arr[mid] < key`, search in the right half (`low = mid + 1`).
        - Else, search in the left half (`high = mid - 1`).
5. If the key is found, print its position (1-indexed).
6. If not found, print not found message.

Algorithm:

1. Start
2. Read n
3. Read array `arr`
4. Sort the array (since binary search requires sorted array)
5. Read key k
6. Set `low = 0, high = n-1`
7. While `low <= high`
    - `mid = (low + high) // 2`
    - If `arr[mid] == k`, return `mid + 1`
    - Else if `arr[mid] < k`, set `low = mid + 1`
    - Else, set `high = mid - 1`
8. If not found, print not found message
9. Stop

Input:

8

3 4 6 -9 10 8 9 30

10

Output:

Element 10 is found at position 5

Program :

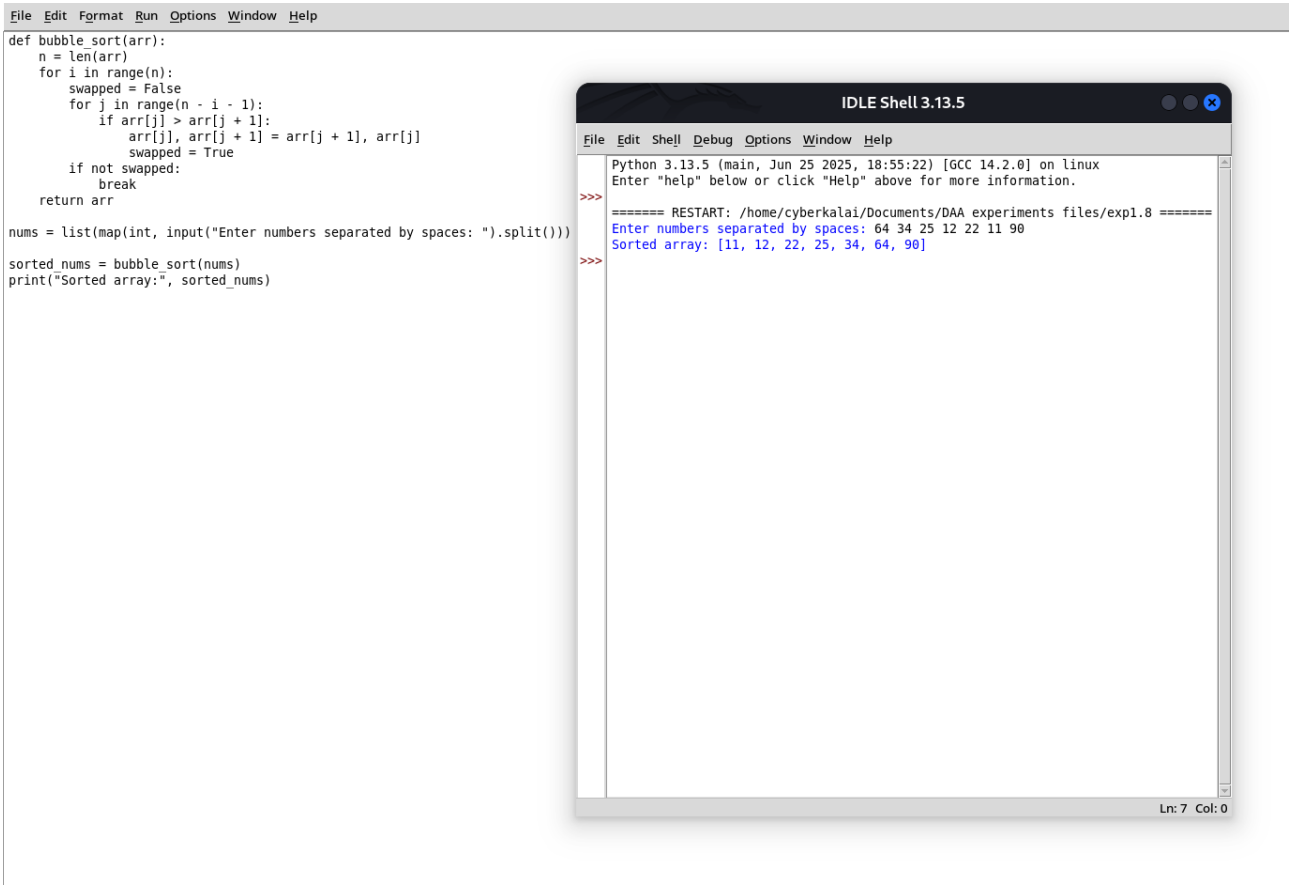
```
def binarySearch(arr, key):
    low = 0
    high = len(arr) - 1
    while low <= high:
        mid = (low + high) // 2
        if arr[mid] == key:
            return mid + 1  # 1-indexed position
        elif arr[mid] < key:
            low = mid + 1
        else:
            high = mid - 1
    return -1
n = int(input("Enter size of array: "))
arr = list(map(int, input("Enter array elements: ").split()))
arr.sort()  # Sorting before binary search, as binary search requires sorted array
key = int(input("Enter key to search: "))

pos = binarySearch(arr, key)
if pos != -1:
    print(f"Element {key} is found at position {pos}")
else:
    print(f"Element {key} is not found")
```

Performance Analysis:

Time Complexity: O(log n)

Space Complexity: O(1)

program output:



Result :

Thus the given program Binary Search is executed and got output successfully.