

CSE221 – Home Assignment 1

BRAC UNIVERSITY | FALL 2023

Deadline: 02-Oct-2023 (Thursday) 11:59 PM | (No Late Submission Accepted)

Total Mark: 15 (5 questions * 3 marks each)

- 1.** You are trying to determine the newsfeed post order. The previous engineer's implementation only showed the most recent posts first. However, there have been numerous complaints about users who spam the platform by posting a thousand pictures simultaneously. Therefore, you came up with an idea: the posts by the user with the highest post count will be displayed last. In other words, the posts by users will be shown in ascending order of their post counts. So, you printed the data of the counts of the newest posts:

id	0	1	2	3	4	5	6	7	8	9
post count	8	12	3	5	2	17	9	14	2	3

You have been instructed by your supervisor to improve the sorting algorithm. While still aiming for optimal time complexity, you are now more cautious and choose an algorithm with a “ $n \log n$ ” time complexity in the best, worst, and average cases.

- a.** Describe this new algorithm by showing the steps of sorting the above list using it.
- b.** You are thinking about adding a new feature, where a user can search if someone has posted n pictures recently. For example, Max can search if anyone has posted 17 pictures recently, and Daisy’s name will pop up (user id:5, post count:17). Since the post count list will already be sorted, you’ll be able to implement this efficiently.

Describe this searching algorithm and show the steps on the post count list by searching for post count: 9.

- 2.** After working with the binary search algorithm, as a CSE221 student you want to explore its strength. You have several ideas in your mind. Try to modify the algorithm to implement your ideas.
- a.** What if you want to return the first index of the search key in case there are duplicates? For example, your search key is 13 and there are three 13s in the list.

3. You are given an array containing N distinct integers in a wave-like sequence. Meaning, the numbers in the beginning are in ascending order, and after a specific position, they are in descending order. For example: [1, 3, 4, 5, 9, 6, 2, -1]

You have to find the maximum number of this sequence. Can you devise an efficient algorithm such that the time complexity will be less than $O(N)$? *[This is one of the midterm questions from previous semesters]*

- Present your solution idea as a pseudocode/ python code/ flowchart/ step-by-step instruction/ logical explanation in one-two paragraphs.
- Write the time complexity of your algorithm.

4.

Index	0	1	2	3	4	5	6	7
Number	23	2	19	3	7	11	5	13

Consider the following list:

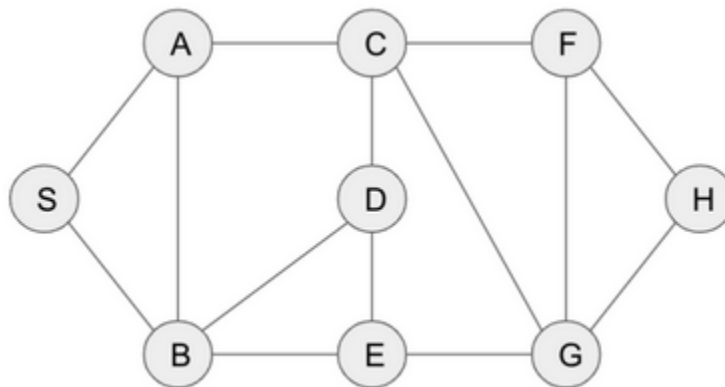
Will the algorithm given on the right be able to find the search value $T=2$ for the list above?
If yes, **show** the value of L , R , m in each step of the algorithm. If no, **explain** why not.

```

function binary_search(A, n, T) is
    L := 0
    R := n - 1
    while L ≤ R do
        m := floor((L + R) / 2)
        if A[m] < T then
            L := m + 1
        else if A[m] > T then
            R := m - 1
        else:
            return m
    return unsuccessful
  
```

Here, A denotes the list, and n denotes its size.

5. Consider this graph:



- Justify $\sum \deg(v) = 2m$, where m = number of edges in the graph.
- Create an adjacency matrix for this graph.
- Apply Depth First Search to traverse this graph considering S to be the source vertex. Demonstrate the results.