

United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid Exam: Spring 2025

Course Code: CSE 2215, Course Title: Data Structures and Algorithms 1

Total Marks: 30

Duration: 1 hour 30 minutes

Answer all questions. Marks are indicated in the right side of each question.

[Any examinee found adopting unfair means will be expelled from the trimester/program as per UIU disciplinary rules.]

1. a) Show the simulation of Descending Order Mergesort and Quicksort on the provided data set :
24, 3, 1, 10, 11, 13 [2+2= 4]

b) For each of the following data sets determine how many times the condition of the while loop in the Insertion Sort Algorithm (for sorting in ascending order) will be evaluated. [2]

```
InsertionSort(A){  
    for( j = 2 to A.length){  
        key = A[j] ④  
        i = j - 1 ⑨  
        while( i > 0 and A[i] > key){  
            A[i+1] = A[i]  
            i = i - 1  
        }  
        A[i+1] = key  
    }  
}
```

Data Set-I: 5, 15, 25, 35, 45
Data Set-II: 50, 40, 30, 20, 10 ④

c) Scenario 1: A teacher wants to sort class test marks (integers from 0 to 20) of 100 students in a section. ③

Scenario 2: A teacher wants to sort UIU student IDs ranging from 230000 to 239999.

For which scenario is Counting Sort suitable? Justify your answer. If it is not suitable, suggest a better alternative and explain why. [2]

2. a) Consider a memory system with column-wise memory allocation, where C[50][100] is a char array (each character occupies 1 byte of space in the memory). Assume that you are given the address of the last element of the array which is 5000. Calculate the memory address of the base element C[0][0]. [2]

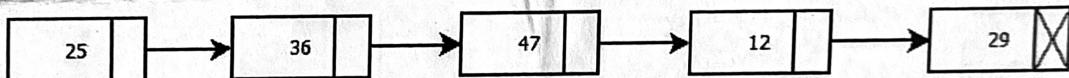
b) You are given two arrays A = [7 12 18 21 -23] and B = [21 18 12 7 5 -23]. In both cases you have to search for the key K=5 in these arrays. You have two choices : using linear or binary search algorithms. Determine which algorithm works best on each of the arrays and simulate your search process for both arrays. [5]

3) a) Consider the following functions 'X' and 'Y'. Find the time complexity of the functions using asymptotic notation. [4]

1. ~~X~~ void X(int i, int j, int num, int arr[]) { $O(n)$
2. if(i == j) return;
3. int mid = (i+j)/2;
4. if(num <= arr[mid]) {
5. return X(i, mid, num, arr);
6. }
7. else {
8. return X(mid+1, j, num, arr);
9. }
10. }
11.
12. void Y(int i, int j, int num, int arr[]) {
13. if(i == j) return;
14. int mid = (i+j)/2;
15. Y(i, mid, num, arr);
16. Y(mid+1, j, num, arr);
17. }

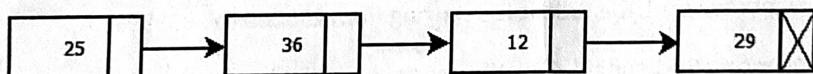
b) Prove the running time of $f(n) = \frac{1}{3}n^3 - 2n^2$ is $\theta(n^3)$. [2]

4. a) Consider the following linked list:

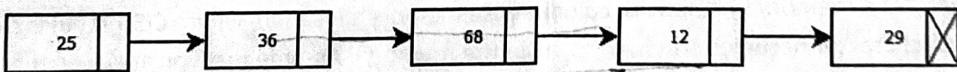


Suppose you want to delete the node with value 47 and insert a new node with value 68 in its place.

After deletion:



After insertion:



Write down the necessary code segments to perform these two operations. [4]

b) Consider a double linked list. You have the head node available. Write a code segment to print the data from all the odd valued elements in reverse order. [3]

c) To implement a circular single linked list, we take a global pointer that points to the Last node instead of the Head node. Explain why this is done. [2]