

**AUTUMN MID SEMESTER EXAMINATION-2022**

School of Computer Engineering
Kalinga Institute of Industrial Technology, Deemed to be University
Design & Analysis of Algorithms
[CS 2012]

Time: 1 1/2 Hours

Full Mark: 20

Answer any four Questions including Q.No.1 which is Compulsory.

The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Answer all the questions.

[1 x 5]

a) $\log(n!) = O(n \log n)$ True/False? Justify your answer.

b) Consider the following function:

```
int FUN(int n)
{
    int i, j, k = 0;
    for (i = n; i > 0; i--)
        for (j = 1; j <= n; j = j * 2)
            k = k + 2/n;
    return k;
}
```

What is the most approximate returned value of the above function?

A) $\Theta(\log n)$ B) $\Theta(n^2 \log n)$ C) $\Theta(n^3)$ D) $\Theta(n^3 \log n)$

c) Where you can find the largest element in a min-heap? Justify your answer by taking a suitable example.

d) Given items as {value, weight} pairs $\{\{30,10\}, \{40,20\}, \{20,5\}\}$. The capacity of knapsack=10. Find the maximum value output assuming items to be divisible and non-divisible respectively.

A. 30, 30 B. 30, 35 C. 35, 30 D. 35, 35 E. NONE

e) Given 5 activities, $A = \langle a_1, a_2, \dots, a_5 \rangle$ along with their start time (s_i) and finish time (f_i) are given as follows:

i	1	2	3	4	5
s_i	3	2	5	4	6
f_i	4	4	7	8	9

Which of the following activity will never participate in finding all possible schedules in activity selection problem.

A. a_2 B. a_3 C. a_4 D. a_5 E. NONE

2. In a class, there are m boys and n girls. Their CGPA's are stored in two arrays B & G, one for the boys(B) in descending order, the other for the girls(G) in ascending order. Devise an $O(m+n)$ algorithm to find out the set (A) of duplicate CGPA's that are common between both the boys and girls in ascending order.

Sample Input=>

Array B={9.5, 9.0, 8.0, 8.0, 8.0, 7.5, 6.5, 5.5, 4.5, 4.5, 4.5, 4.0, 4.0}

Array G={4.5, 4.5, 5.5, 6.5, 6.5, 6.5, 8.0, 8.0, 9.5, 9.5}

Output => Array A={4.5, 8.0}

[5 Marks]

3. a) Write a recursive algorithm named as FIND-ARRAY-MAX(A, n) to compute the maximum element in an array of n integers by assuming the existence of a function "max(x, y)" that returns the maximum of two integers x and y. [2.5 Marks]
 b) What is the exact comparison complexity of FIND-ARRAY-MAX(A, n) algorithm? Derive a recurrence relation and solve it to justify your answer. [2.5 Marks]
4. Write an algorithm MAX-HEAP-DELETE(A, n, i) to delete an element at index i, in a n-element max heap A, rooted is at index 1, by assuming the existence of two algorithms HEAP-INCREASE-KEY(A, n, i, key) and MAX-HEAPIFY(A, n, i), where,

HEAP-INCREASE-KEY(A, n, i, key) is an algorithm that rebuild the n-element max-heap A if value at index i increases to the new value key, which is assumed to be at least as large as i's current key value, else display appropriate error message.

MAX-HEAPIFY(A, n, i) is an algorithm where, the value at A[i] may "float down" in the n-elements max-heap A so that the sub tree rooted at index i obeys the max-heap value property. Apply MAX-HEAP-DELETE(A, 11, 9) and MAX-HEAP-DELETE(A, 11, 1) separately to the following max-heap array A.

A={20, 15, 14, 10, 13, 8, 5, 7, 9, 12, 11}

[5 Marks]

5. Suppose a file to be transferred through the network contains the following characters with their number of occurrences as < a: 10, b: 25, c: 15, d: 30, e: 20 >. Determine an efficient strategy that can minimize the total cost of transferring that file of 1000 characters. Find out the total cost of transfer if transferring cost for 1-bit of data is 4 units. [5 Marks]

*** Best of Luck ***