

Reg. No.:

Name :



VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act 1956)

Continuous Assessment Test II- July '23

Programme	: B.Tech.(CSE)	Semester	: Fall Inter
Course Title	: Design and Analysis of Algorithms	Code	: BCSE204L
		Slot	: C2 + TC 2
Faculty (s)	: Dr. Manimegalai T Dr. Kalaipriyan T Dr. Om Kumar C.U. Dr. A.R Revathi Dr. Muthukumaran K Dr. Pavithra L K	Class Nbr(s)	: CH2022232501098, CH2022232501099, CH2022232500927, CH2022232500935, CH2022232500937, CH2022232500928
Time	: 90 Minutes	Max. Marks	: 50 marks

Instructions:

- ✓ Answer all the FIVE questions.
- ✓ If any assumptions are required, assume the same and mention those assumptions in the answer script.
- ✓ Your answer for all the questions should have both the 'design' component and the 'analysis component'
- ✓ The 'Design' component should consist: logic to develop the pseudocode, illustration, pseudocode.
- ✓ The 'Analysis' component should consist: Computation of T(n), Time-complexity.

1. You are given an encoded message consisting of digits from '0' to '9'. Each digit can be mapped to a corresponding letter from 'A-1', 'B-2', and 'Z-26' using a specific mapping. To decode the message, the digits must be grouped in a valid way and mapped back into letters based on the reverse mapping. For example, consider the string "11106". It can be decoded in multiple ways, such as "AAJF" with the grouping (1 1 10 6) or "KJF" with the grouping (11 10 6). However, the grouping (1 11 06) is invalid because the digit "06" cannot be mapped into a letter since it is different from "6". Design an algorithm that returns the total number of valid ways to decode a particular string and analyse its time complexity.

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Rubrics

Logic (2), Pseudocode(3), Illustration (3), Time Complexity (2)

2. Given the dimension of 'n' matrices, write an algorithm to form a compatible sub chain of matrices to perform matrix multiplication. There may be more than one compatible sub chain for the given chain of matrices. You may pick any one sub chain of length more than 3. Sub chain may include 'm' matrices in the order as given in the input, where $m \leq n$. Using dynamic programming, parenthesize the sub chain obtained in such a way that minimum number of scalar multiplications are required. For example, if there are eight matrices with following dimension:

A1 - 30 x 35 A2 - 30 x 25 A3 - 35 x 15 A4 - 10 x 20 A5 - 15 x 5 A6 - 5 x 10 A7 - 10 x 20 A8 - 20 x 25

Then compatible sub chain of matrices is A1, A3, A5, A6, A7, A8 and the minimum number of scalar multiplications required is 15125.

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Rubrics

Logic (2), Pseudocode (3), Illustration (3), Time Complexity (2)

3. In a square grid of size $N * N$, a rat is initially positioned at cell (0, 0) and needs to reach the destination at cell ($N - 1, N - 1$). The rat can only move in four directions: up, down, left, and right. Some cells in the grid are blocked (denoted by 0) and the rat cannot move through them, while other cells are open (denoted by 1) and the rat can traverse through them. However, there is a twist - there are two special cells marked as "teleporters" (denoted by T) scattered throughout the grid. When the rat encounters a teleporter cell, it may or may not jump to the other teleporters cell on the grid.

1	0	1	T
1	1	1	0
0	1	T	1
1	1	1	1

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Devise an algorithm to find all possible paths that the rat can take to reach the destination.

Rubrics

Logic (2), Pseudocode(3), Illustration (3), Time Complexity (2)

4. 'Pick letters' is a kid's game in which a one-dimensional board of size 'n' and a box of 's' letter pieces. There are 'm' different letters in the box. Each letter in the box has a dimension and a score. The kid has to select few letters from the box in such a way that:

- Total dimension of the letters chosen do not exceed 'n'
- Sum of the scores of the letters chosen is maximum
- Number of vowels do not exceed 20% of n
- He may pick one or more of the same letter but should not exceed the number of letter pieces of the selected letter

For example, if the dimension of the board is 50, and there are five letters with dimension and score as given below:

Letter	Number of Letter Pieces	Dimension	Score
A	5	5	8
B	3	4	12
E	8	2	10
D	4	3	4
I	10	2	3

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Then the letters chosen will be B-3, E-8, A -2, D - 4 with maximum score as 148.

Rubrics

Logic (2), Pseudocode(3), Illustration (3), Time Complexity (2)

5. Consider the following algorithm.

Algo XXX (T, P)

```

N=T.length
M=P.length
for i=0 to N-M
    count=0
    for j=1 to M
        if T[i+j] != P[j]
            count++
    if count<=2
        print ("exists at i")

```

return count,i

- Trace and write the output for the following input
 - $T = \text{ACAACAAZBXCYAAB}; P = \text{ABAB}$ [2 Marks]
 - $T = \text{XYZJXYZXYZJ}; P = \text{IYXJ}$ [2 Marks]
- Compute the time complexity of the Algo XXX () [2 Marks]
- Describe the functionality of the above algorithm with the description for each line of the algorithm [2 Marks]
- Prepare an algorithm YYY() that does the same job as of Algo XXX() and prove that YYY() algorithm is efficient than algorithm XXX() [2 Marks]

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