VIT

Vellore Institute of Technology

Continuous Assessment Test II - March 2023

Programme	B.Tech.(CSE)	Semester	Winter 2022-23
Course	Design and Analysis of Algorithms	Code	BCSE 204L
Faculty	Dr.L.Jeganathan, Dr B Jayaram, Dr M Janaki Meena, Dr T Kalai priyan, Dr U Srinivasa rao, Dr L K Pavithra	Slot/Class No.	B2/CH2022235000286/ CH2022235000287/ CH2022235000288/ CH2022235000289 /CH2022235000291/ CH2022235000292
Time	90 Minutes	Max. Marks	50

Instructions:

- Answer all the FIVE questions.
- If any assumptions are required, assume the same and mention those assumptions in the answer script.
- Use of intelligence is highly appreciated.
- Your answer for all the questions should have both the 'design' component and the 'analysis component'
- The 'Design' component should consist: understanding of the problem, logic to develop the pseudocode, illustration, pseudocode.
- The 'Analysis' component should consist: Computation of T(n), Time-complexity.
- For question numbers. 1 & 2, rubric is : Logic (2 marks), Illustration(3 marks), Pseudocode(3 marks), running-time and the time-complexity (2 marks).
- For question Nos. 1,2 & 3, rubric is : Logic (2 marks), Illustration(3 marks), Pseudocode(3 marks),, running-time and the time-complexity (2 marks)
- For question No.5, rubric is : Proposal of the problem (1 marks), logic of the pseudocode A(1 mark), Illustration for A(1 mark), pseudocode A(1 mark), logic for the pseudocode B (2 mark),pseudocode B(1 marks), Illustration for B(1 marks), Time-complexities of A and B and the conclusion (2 marks),

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1. Given a chain of matrices $< A_1, A_2, ..., A_n >$ of n matrices (where each matrix A_i is of size $p_{(i-1)} \times p_i, i = 1, 2, 3, ...n$) and a positive integer k , design a dynamic programming based pseudocode to fully parenthesize the product $A_1 * A_2 * ... * A_n$ in such a way that the number of scalar multiplications is minimum subject to the constraint that the parenthesized chain has a sub chain of lěnght k in both the beginning of the chain and at the end of the chain. For example, If the inputs are $< A_1, A_2, ...A_{12} >$ and 3, task is to compute the parenthesization of the expression : $(A_1 * A_2 * A_3) * A_4 * A_5 * A_6 * A_7 * A_8 * A_9 * (A_{10} * A_{11} * A_{12})$. Your pseudocode should output both the parenthesization of the chain as well as the minimum number of scalar multiplications. Your design component should contain all the required steps. Analyse the algorithm with all the required steps. [10 Marks]

2. Consider a grid of size $m \times n$, with m rows and n columns. Every cell is referred with a pair (i, j) which conveys that the cell is at the intersection of the i^{th} row and the j^{th} column. With a grid of size 4×3 starting from the Cell $(1, 1)$, one can reach the cell $(4, 3)$ by navigating the path

$$(1, 1) - (1, 2) - (1, 3) - (2, 3) - (3, 3) - (4, 3).$$

In the grid, some cells are marked X which means that we cannot navigate through this cell (which are marked X), either from top or bottom or left or right. A grid of size 4×4 with the cells $(2, 1)$ and $(1, 3)$ marked X will look like:

		X	
X			

Given $m, n, b_1, c_1, b_2, c_2, ..., b_k, c_k, p, q, r, s$, design a pseudocode to compute the path that starts from the cell (p, q) and reaches the cell (r, s) such that the path does not contain cells marked X. Here $m \geq p$, $m \geq r$, $n \geq q$, $n \geq s$. In the input sequence $m, n, b_1, c_1, b_2, c_2, ..., b_k, c_k, p, q, r, s$, the first two intgers m and n indicate the size of the grid as $m \times n$. The intgers $(b_1, c_1, b_2, c_2, ..., b_k, c_k)$ indicate that the cells (b_1, c_1), (b_2, c_2),...(b_k, c_k) are blocked with X mark. The integers p, q, r, s indicate that the source cell is (p, q) and the target cell. Your design component should contain all the required steps. Analyse the algorithm with all the required steps. [10 Marks]

3. Given a set of jobs $S = \{J_1, J_2, ..., J_n\}$, where each J_i is represented by a triplet, $J_i =< n_i, s_i, f_i >$, where n_i is the number of persons required for the job J_i, s_i is the start time of the job and f_i is the finishing time of the job, in a given day. Given S, design a greedy based pseudocode to identify the jobs that can be scheduled in such a way that (i) Only one job can be executed at a time (ii) Maximum number of jobs can be scheduled in a day. (iii) No job should have a duration of less than 2 units of time. Your design component should contain all the required steps. Analyse the algorithm with all the required steps. [10 Marks]

4. Consider the following algorithm.

Algorithm 1 XXXX

```
Input : X, Y
n=X.length
m= Y.length
s=[]
for i = 1 to n do
   for j = 1 to m do
      if X[i]==Y[j] then
         s.append ((i,j))
      end if
   end for
end for
```

Understand the functionality of the above algorithm and answer the following.

(a) Write the output of the algorithm when X = 23142, Y=3541 [2]

(b) Write the output of the algorithm when X = abbcd, Y=bbef [2]

(c) Describe the functionality of the above algorithm with the description for each line of the algorithm [4]

(d) Compute the time-complexity of the algorithm. [2]

5. Propose a problem in detail (of your choice), which is not discussed in your class-room as well as in the lab sessions. Write a non-recursive brute-force pseudocode A to solve the problem proposed by you. Compute the time-complexity of the pseudocode A. Transform your pseudocode A into an equivalent pseudocode B which uses the greedy strategy. Compute the time-complexity of both the pseudocodes A and B and identify the efficient one. Note that you are required to propose a problem for which a greedy based pseudocode is possible.
[10 Marks]

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