CSE 3131: ALGORITHM DESIGN 1

ASSIGNMENT 6:

Submission due date:25/01/2023

- *Assignment scores/markings depend on neatness and clarity.*
- *Write your answers with enough detail about your approach and concepts used, so that the grader will be able to understand it easily. You should ALWAYS prove the correctness of your algorithms either directly or by referring to a proof in the book.*
- *The marking would be out of 100.*
- *You are allowed to use only those concepts which are covered in the lecture class till date.*
- *Plagiarized assignments will be given a zero mark.*

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*CO6: to understand various types and aspects of **Dynamic Programming**.*

Dynamic Programming:

Sl.No.	***Question***	***PO***	***Level***
1.	Design an algorithm using Dynamic Programming approach for the given function description. $$f(n) = \begin{cases} n & n = 0\ or 1 \\ f(n) + f(n-1) & n > 1\ and\ even \\ f(n) + f(n-2) & n > 1\ and\ odd \end{cases}$$	PO2,PO3,PO4	L5
2.	Let A be an NXN 2D array with all distinct elements, in which all rows and all column are sorted in descending order from larger to smaller indices. Given key M , find out M is present in this 2D array A. Design a recursive algorithm to solve this and it must run in O(nlogn) time.	PO2,PO3,PO4	L2,L3
3.	Assume that multiplying a matrix M_1 of dimension p×q with another matrix M_2 of dimension q×r requires pxqxr scalar multiplications. Computing the product of n matrices $M_1xM_2xM_3x..xM_n$ can be done by parenthesizing in different ways. Consider a multiplication of form M_ixM_{i+1} as an explicitly computed pair for a given parenthesized form if they are directly multiplied. For example, in the matrix multiplication chain $M_1M_2M_3M_4M_5M_6$ in the parenthesized form $((M_1(M_2M_3))(M_4(M_5M_6)))$, M_2M_3 and M_5M_6 are only explicitly computed pairs. Consider a matrix multiplication chain $M_1M_2M_3M_4M_5$, which are of dimensions 2×25,25×3,3×16,16×12 and 12×4, respectively. Find the optimal parenthesized form and mention the explicitly computed pairs if any.	PO2,PO3,PO4	L5
4.	Your institute has a huge event room V0. Several events are organized there, including classes, tutorials, tests, dramas, chess competitions, sarod recitals, robot design	PO2,PO3,PO4	L5,L6

	contests, food festivals and social gatherings. Each such event has a start time and an end time. Mr. ALGORITHM is in charge of scheduling events in V0. He has a list of forthcoming events that request the room V0. Since multiple events cannot run simultaneously in V0, Mr. ALGORITHM's task is to select a non-overlapping set of events. He has two objectives in mind. i) Schedule as many (non-overlapping) events as possible. ii) Schedule (non-overlapping) events in such a way that V0 is utilized for the maximum duration. Formulate the problem recursively as follows. Suppose that the intervals I_1, $I_2, I_3 \ldots \ldots I_N$ are sorted with respect to their left end points (start times). Now, consider two possibilities: include I_1, and do not include I_1 in your list of scheduled intervals. If you include I_1, then find out the first compatible interval after I_1 in the sorted list (provided that such an interval exists). Let this interval be I_K. You then recursively find an optimal schedule among the intervals I_K through In. Also add the utilization produced by the inclusion of I_1. On the other hand, if I1 is not included, recursively compute an optimal schedule from the intervals I_2 through I_N. Take the larger of these two as the final optimal solution. Identify the bottom, solve small subproblems (and store the results in an array), and gradually solve larger problems using the solutions already computed, until you solve the problem for the entire collectionI_1, $I_2, I_3 \ldots \ldots I_N$. Your dynamic-programming implementation must run in O(N log N) time		
5.	Identify the overlapping subproblems for this problem. Detect how many subproblems are to be solved to get the answer when (w1, w2, w3, w4)= (117, 113, 114, 115) and (p1, p2, p3, p4)=($4200, $1200, $4000, $2500) with bag capacity W=100.	PO2,PO3,PO4	L5
6.	Suppose we are given a directed graph $G = (V, E)$, with costs on the edges; the costs may be positive or negative, but every cycle in the graph has strictly positive cost. We are also given two nodes $v, w \in V$. Give an efficient algorithm that computes the number of shortest v-w paths in G. (The algorithm should not list all the paths; just the number suffices.)	PO2,PO3,PO4	L2,L3

Submission and Grading:

Submit the hard copy of your assignment by the due date, i.e. 25.01.2023.

Part of your assignment grade comes from its "external correctness." This is based on correct output on various sample inputs.

The rest of your assignment's score comes from "internal correctness." Internal correctness includes:
1. Use of methods to minimize the number of steps.
2. Appropriate use of rules, axioms, and suitable diagrams to enhance readability of your responses.

Send a zip folder (name of the zip folder must be your registration number_AD1) containing the code and output file/screen-shot of each program implementation mentioned to the official email id of your AD1 class teacher. On the top of each program, you must mention your full name, registration number, title of the program and date.