



COMSATS UNIVERSITY ISLAMABAD

DEPARTMENT OF COMPUTER SCIENCE

Mid Term Examination, Fall 2022

Class/Section: -BSCS – 5A/B, BDS-4, BCT-4, BAI-4

Marks: - 25

Subject: -Design and Analysis of Algorithm

Time: - 90 minutes

Instructor: -Tanveer Ahmed Siddiqui

Dated: - November 16, 2022

CLO-3: Design an algorithm for a computational problem by employing an appropriate algorithmic approach.

Question # 01: ----- CLO-3-----Marks = [4]

Design an algorithm using *Divide and Conquer* strategy for the following problem.

Problem: Given a list of n distinct positive integers, partition the list into two sub-lists, each of size $n/2$, such that the difference between the sums of the integers in the two sub-lists is maximized. You may assume that n is a multiple of 2.

Question # 02: ----- CLO-3----- Marks = [2+1+2+2+1+2+3]

A robot can take steps of 1 meter, or 2 meters. Design an algorithm using *Dynamic Programming* (DP) to output all of the ways the robot can walk n meters (with order taken into account).

2-A) Write down a *recursive formula* for the whole problem in terms of the answers to smaller sub-problems.

2-B) Draw *recursion tree* using the formula that you describe in part (2-A) for $n = 6$

2-C) Convert the recursion tree that you build in part (2-B) into *Directed Acyclic Graph (DAG)*.

2-D) Find *topological order of DAG* that you construct in part (2-C).

2-E) Which *data structure* you will choose to *memoize* intermediate results.

2-F) Fill in the cells of above *data structure* using formula given in part (2-A) in the order that you obtained in part (2-D).

2-G) Write Pseudocode of your algorithm (both memoization and bottom-up version of DP)

Question # 03: ----- CLO-3----- Marks = [4+4]

Suppose you want to sort an array of n items in ascending order. You design the algorithm for sorting problems by employing *Transform and Conquer* strategy as follows:

Stage 1: Transform the given array into Heap.

Stage 2: Apply the root-deletion operation $n-1$ times to the remaining heap.

3-A) Write Pseudocode of your algorithm.

3-B) Sort the following array using Heap sort algorithm design in part (3-A). Show all your work step by step

2	9	7	6	5	8
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Best of Luck