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# ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

## Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

SUMMER SEMESTER, 2021-2022

DURATION: 1 HOUR 30 MINUTES

FULL MARKS: 50

### CSE 4809: Algorithm Engineering

**Programmable calculators are not allowed. Do not write anything on the question paper.**

Answer **all 3 (three)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

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1. a) Answer the following questions with single sentence only: 1 × 3
- i. Write names of two applications that use memory based balanced tree. (CO2)
  - ii. Why are memory-based balanced trees not suitable for disc based search and indexing? (PO1)
  - iii. Mention one application area where  $\log_2 \log_2(n)$  algorithm is taken as a significant improvement over  $\log_2(n)$ .
- b) Given a regular recursion:  $T(n) = aT(n/b) + f(n)$  7.67  
If  $f(n) = O(n^{\log_b a - \epsilon})$ , prove that  $T(n) = \theta(n^{\log_b a})$ . (CO1)  
(PO1)
- c) With three example instances, show the key insertion mechanism of B<sup>+</sup> Tree. Assume  $t = 3$ . 6  
(CO2)  
(PO1)
2. a) What is quasi polynomial time algorithm? Outline the solution for 0-1 Knapsack problem and justify its complexity as quasi polynomial. Mention at least one more algorithm that is also quasi polynomial. 5  
(CO1)  
(PO1)
- b) How is GPU parallelism used to speed up the training in Deep Learning setup? 6.67  
(CO2)  
(PO1)
- c) Briefly describe one divide and conquer algorithm that is used in recent research related to you. 5  
(CO4)  
(PO1)
3. a) Answer the following questions with single sentence only 1 × 4
- i. How is Catalan number related to matrix chain multiplication? (CO2)
  - ii. "Every problem that has an optimal greedy algorithm should also have a dynamic programming solution"- why? (PO1)
  - iii. Why does the longest simple path finding problem not have an optimal substructure property?
  - iv. Can dynamic programming solve multi-objective optimization problem? Justify your answer.
- b) Write down the optimal substructure equation for DTW after briefly describing the optimization problem the algorithm attempts to solve. Comment on the complexity of the DTW algorithm. 5.66  
(CO2)  
(PO1)

- c) Given a grid of  $(m \times n)$  dimension containing cells filled with reward (positive or negative), the reward of an area will be the sum of rewards of all the cells within the area.

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(CO2)  
(PO1)

If a problem is defined as to find the maximum possible reward from a minimum square:

- i. Can you use Dynamic Programming algorithm for the problem defined above? If so, what will be optimal substructure for the problem?
- ii. If Dynamic Programming cannot be used in this context or the benefit of using the algorithm is hindered for some reason, point out why?