B.Sc. Engg. CSE 8th Semester 25 October 2019

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **SUMMER SEMESTER, 2018-2019**

DURATION: 3 Hours **FULL MARKS: 100**

CSE 4809: Algorithm Engineering

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

There are **8 (eight)** questions. Answer any **6 (six)** of them including **Question 1 (mandatory)**.

Figures in the right margin indicate marks.

[Mandatory]

1. a) What is reducibility of a problem? Explain its usage in deciding tractability of a problem. 4
   b) Reduce 0-1 Knapsack problem to CNF-Satisfiability problem. 5
   c) Given the recursion 8

$$T(n) = aT(n/b) + f(n), \quad a \geq 1, b > 1$$

Prove that if $f(n) = O(n^{\log_b^a - \varepsilon})$ for some constant $\varepsilon > 0$ then $T(n) = \Theta(n^{\log_b^a})$

   d) Comment on the hardness of the problem of 'data mining'. 3

2. a) Show the results of inserting the keys 8

F, S, Q, K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E

with minimum degree 3.

   b) Given the flow network defined by the adjacency list: 8

source -> v_1 = 16
source -> v_2 = 13
v_1 -> v_3 = 12
v_2 -> v_1 = 4
v_2 -> v_4 = 14
v_3 -> v_2 = 9
v_3 -> sink = 20
v_4 -> v_3 = 7
v_4 -> sink = 4

Find the maximum flow for the network.

3. a) Prove that the expected running time of a randomized quicksort is $\Theta(n \lg n)$. 8
   b) Explain the concept of map-reduce with a simple example. 8

4. a) Construct the dynamic programming algorithm for DTW and Viterbi algorithm. 8
   b) Compute π function for the pattern ***P=ababaca***. Use the π function to construct a state transition diagram for the same pattern ***P***. 8

5. a) What is traveling-salesman problem? Prove that the traveling-salesman problem is NP-complete. 6

   b) Provide a polynomial time 2-approximation algorithm for traveling salesman problem with triangle inequality. Comment on its complexity also. 5+5

6. a) Comment on the possibility of achieving parallelism by divide and conquer approach for the following problems: 6
      i. Web page request from one million users simultaneously.
      ii. Sorting a huge data set.
      iii. A machine learning algorithm.

   b) What is apriori property? Why does every data mining algorithm uses apriori property? 5

   c) How does FP-Tree/ FP-Growth algorithm improves over Apriori algorithm for association pattern mining? 5

7. a) Prove that if $n \geq 1$, then the height h for any n-key B-tree T with minimum degree $t \geq 2$, is 6
   $$h \leq \log_t((n+1)/2)$$

   b) Solve the following recurrence using master method and using recursion tree 10
   $$T(n) \leq T(2n/3) + \Theta(1)$$

8. a) Digital map users frequently asks for direction from the map services. However, their mode/ intentions are not the same. Sometimes they are in a hurry and wants a quick estimate of the distance from source to a particular destination. In other cases when they are serious they want to find the optimum route based on just distance, or with combination of other parameters such as traffic condition. Explain with details how you will use dynamic or greedy algorithms in different requirements of the user. 8

   b) What are the relations between dynamic programming and back tracking? Can they be used interchangeably in a practical problem? Explain. 8