PhD/ M.Sc. Engg. CSE

28 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: 150**

CSE 6283: Advanced Algorithms

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

There are **7 (seven)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) Define Turing Machine. How did Turing prove that *Halting Problem* is undecidable? 9
   b) Prove that 0-1 Knapsack problem is NP-hard. 8
   c) Given the recursion 8

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

Prove that if $f(n) = \Omega(n^{(\log_b^a + \varepsilon)})$ for some constant $\varepsilon > 0$ and if $af(n/b) < cf(n)$ then

$T(n) = \Theta(f(n))$

2. a) Show the results of inserting the keys in a B-Tree with minimum degree 3: 9

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

   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.

   c) Prove the correctness of Dijkstra's algorithm for finding single source shortest paths. 8

3. a) In an e-commerce site customers browse the products randomly by clicking on the links and thumbnails. The browsing habits indicate their buying habits and hence can be mined for product recommendations. Elaborate the idea of using association rule mining, sequence mining, and graph mining in click streams for product recommendations. 18
   b) Comment on the hardness of the problem 'data mining'. 7

4. a) Can machine learning solve NP problems? Explain your answer. 7
   b) Briefly describe the working procedure of machine learning algorithms. 8
   c) How do different machine learning algorithms (mention 2 algorithms) learn the decision boundary for a classification problem? 10

5. a) Write down the recursive equations for all- pair shortest path problem include the formulation given by Floyd-Warshall. 10
   b) Construct/Define the dynamic programming algorithm/ equation for DTW and Viterbi algorithm. 15

6. a) What is the complexity of a naïve string matching algorithm? 5
   b) How does Rabin-Karp algorithm improve over the naïve string matching algorithm? 10
   c) Compute π function for the pattern ***P=ababacaa***. Use the π function to construct a state transition diagram for the same pattern ***P.*** 10

7. a) Explain ***$\rho(n)$- approximation*** ratio? 7
   b) Write down a 2-approximation algorithm for vertex cover problem. Also comment on its complexity. 18