KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

Marks Scored:

Level : B.Sc.
Year : III
Course : COMP 314
Semester: II

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date MAR 1 1 2018

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Circle the most appropriate answer.

1. Loop invariant is associated with:
   a. Efficiency of algorithms
   b. Correctness of algorithms
   c. Both efficiency and correctness of algorithms
   d. None of the above

2. The "for" and "while" loops run:
   a. Equal number of times as the loop body
   b. One more time than the loop body
   c. Two more times than the loop body
   d. None of the above

3. Which of the following notations is also known as "asymptotically tight bound"?
   a. Big Oh notation b. Big Omega notation c. Theta notation d. Small Oh notation

4. Heap sort combines the best of:
   a. Selection and Merge Sort
   b. Bubble and Merge Sort
   c. Insertion and Merge Sort
   d. None of the above

5. Hash collision is resolved by means of:
   a. Linear chaining
   b. Rehashing
   c. Randomized hash function
   d. All of the above

6. The LCS length of two strings "springtime" and "pioneer" is:
   a. 3 b. 4 c. 5 d. 2

7. The time complexity of topological sort is:
   a. $\Theta(V+E)$ b. $\Theta(V)$ c. $\Theta(E)$ d. $\Theta(V^2)$

8. The Minimum Spanning Tree problem is a:
   a. P class problem
   b. NP-Hard class problem
   c. NP-complete class problem
   d. None of the above

9. In a heap with n elements and with the smallest elements at the root, the 7'th smallest element can be found in:
   a. $\Theta(n \lg n)$ b. $\Theta(n)$ c. $\Theta(\lg n)$ d. $\Theta(1)$

10. If all edges have the same weight in an undirected graph, which algorithm will find the shortest path between two nodes more efficiently?
   a. Dijkstra
   b. Bellman-Ford
   c. Depth-First Search
   d. Breadth-First Search

11. Rather than build a subgraph one edge at a time, which of the following algorithms builds a tree one vertex at a time?
    a. Kruskal's algorithm
    b. Prim's algorithm
    c. Dijkstra's algorithm
    d. Bellman-Ford algorithm

12. The running time of Dijkstra's algorithm is:
    a. $O(V^2)$
    b. O(E log V)
    c. O(V+E)
    d. O(V.E)

13. In the ..... traversal, we process all of a vertex's descendants before we move to an adjacent vertex.
    a. Depth First
    b. Breadth First
    c. Width First
    d. Depth Limited

14. Which of the following standard algorithms is not a Greedy algorithm?
    a. Dijkstra's shortest path algorithm
    b. Prim's algorithm
    c. Kruskal's algorithm
    d. Bellman-Ford Shortest path algorithm

15. The element at the root of a heap is:
    a. largest
    b. smallest
    c. depending upon the type of the heap, it may be smallest or largest
    d. none of the above

16. A balanced binary tree is a binary tree in which the heights of the two subtrees of every node never differ by more than:
    a. 2
    b. 1
    c. 0
    d. None of the above

17. Find the odd one out:
    a. O(n)
    b. $O(n^2)$
    c. $O(n^3)$
    d. $O(3^n)$

18. The condition Top = -1 indicates that:
    a. Stack is empty
    b. Stack is full
    c. Stack has only one element
    d. None of the above

19. Which of the following represents a cross edge?
    a. (u,v) where u and v are not ancestors or descendants of one another
    b. (u,v) where v is a (not necessarily proper) ancestor of u in the tree
    c. (u,v) where v is a proper descendant of u in the tree
    d. none of the above

20. Which of the following is not true of Flow networks?
    a. Flow in is equal to Flow out in the vertices other than the source and the sink
    b. f(u,v) = -f(v, u)
    c. f(u,v) <= c(u,v)
    d. capacity can have zero or negative values

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SECTION "B"
[4 Q. × 5 = 20 marks]

Attempt *ANY FOUR* questions.

1. What do you understand by the asymptotic efficiency of algorithms? Shed light on the major asymptotic notations and their graphical interpretations.

2. Discuss the working mechanism of merge sort algorithm. Illustrate the operation of merge sort on the array A = <3, 41, 52, 26, 38, 57 ,9 , 49>

3. What are optimization problems? Discuss the applicability of the methods – Dynamic Programming and Greedy Strategy for solving optimization problems.

4. Discuss how Dijkstra's algorithm works for finding shortest paths. What is the concept of "relaxation"?

5. Define the three concepts – "Residual networks", "Augmenting paths" and "Cuts" in the context of the Ford-Fulkerson algorithm.

SECTION "C"
[2 Q. × 10 = 20 marks]

Attempt *ANY TWO* questions.

6. Give the dynamic programming problem formulation of the Matrix Chain Multiplication problem. Given the matrices A_1, A_2, A_3, A_4 and their respective sizes, 5 x 4, 4 x 6, 6 x 2 and 2 x 7, determine the optimal cost and sequence of multiplication via "m" and "s" tables.
[5 + 5 = 10]

7. Write short notes on
[2 × 5 =10]
   a. Red-black trees and operations on the Red-black trees
   b. Branch and bound method and the 8-puzzle problem

8. Discuss the working mechanism of Huffman's algorithm. Apply this algorithm to construct the final tree of characters and their encodings – the characters and their frequencies being: a: 0.05; b: 0.48; c: 0.07; d: 0.17; e: 0.10; f:0.13
[5+5 = 10]