The LNM Institute of Information Technology

Computer Science & Engineering

Design & Analysis of Algorithm, CSE 325

Exam Type: End Term

Time : 180 minutes **Date:**29/04/2017 **Max. Marks:** 100

Name: _____ Enrollment No: _____

Instruction:

- **Attempt all the questions.**
- **Marks for each question are written against them.**
- ***Do not write anything* in *question-paper* except Name and Enrolment Number.**
- **Though careful proof reading has been done for question paper. Even then if you have any doubt/confusion regarding the question you can make your assumption. You must write your assumption clearly before you start attempting that question. If Instructor thinks that your doubt/confusion and assumption is genuine then only he will entertain that assumption and check the question based on assumption otherwise your doubt/confusion/assumption will be ignored.**

All objectives carry (1 for correct choice(s) +2 for reason(s))

1. When you know that the given array of numbers (positive integers) is almost in a sorted form what sorting algorithm you would use and why?
   (a) Insertion Sort (b) Quick Sort (c) Radix Sort (d) Selection Sort

2. Suppose we are sorting an array of ten integers using a some quadratic sorting algorithm. After four iterations of the algorithm's main loop, the array elements are ordered as shown here:
   1 2 3 4 5 0 6 7 8 9
   Which statement is correct and how?
   (a) The algorithm might be either selection sort or insertion sort.
   (b) The algorithm might be selection sort, but could not be insertion sort.
   (c) The algorithm might be insertion sort, but could not be selection sort.
   (d) The algorithm is neither selection sort nor insertion sort.

3. Suppose we are sorting an array of eight integers using quicksort, and we have just finished the first partitioning with the array looking like this: 2 5 1 7 9 12 11 10
   Which statement is correct and how?
   (a) The pivot could be either the 7 or the 9. (b) The pivot could be the 7, but it is not the 9.
   (c) The pivot is not the 7, but it could be the 9. (d) Neither the 7 nor the 9 is the pivot.

4. In a selection sort of n elements, how many times is the swap function called in the complete execution of the algorithm? How?
   (a) 1 (b) $n - 1$ (c) $n \log n$ (d) n^2

5. What is an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers? a:1 b:1 c:2 d:3 e:5 f:8 g:13 h:21

   Can you generalize your answer to find the optimal code when the frequencies are the first n Fibonacci numbers? (4 + 6 Marks)

6. Suppose that a data file contains a sequence of 8-bit characters such that all 256 characters are about equally common: the maximum character frequency is less than twice the minimum character frequency. Prove that Huffman coding in this case is no more efficient than using an ordinary 8-bit fixed-length code. (8 Marks)

7. Give an $O(n^2)$-time algorithm to find the longest monotonically increasing subsequence of a sequence of n numbers. (4 Marks)

8. Give an O(n log n)-time algorithm to find the longest monotonically increasing subsequence of a sequence of n numbers. (6 Marks)

9. Suppose that all edge weights in a graph are integers in the range from 1 to |V|. How fast can you make Kruskal's algorithm run? (5 Marks)

10. Define Hamiltonian Path and Hamiltonian cycle. Suppose you have a magical box which can detect whether any Graph G have a Hamiltonian path or not. Suggest a methodology to find out whether any graph G have a Hamiltonian cycle or not. (7.5 Marks)

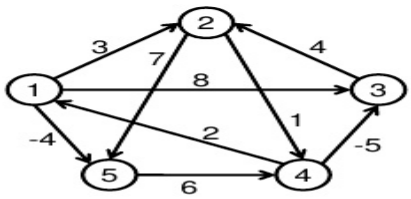
11. The diameter of a Graph G = (V,E) is given by $\max_{u,v \in V} \delta(u,v)$; where $\delta(u,v)$ is the shortest distance between vertex u & v. Design an efficient algorithm to compute the diameter of a graph and also analyze the running time of your algorithm. (7.5 Marks)

12. Let T be a spanning tree of graph G and, for any two vertices $u,v \in V$, let max[u, v] be an edge of maximum weight on the unique path between u and v in T. Describe an O(V2) time algorithm that, given T, computes max[u, v] for all $u,v \in V$. (10 Marks)

13. In a communication network, let network node u and network node v are the adjacent network nodes and r(u, v) represents the reliability of the communication channel from network node u to network node v. Reliability of the channel represents the probability of communication without fail. We assume that these probabilities are independent and uniformly distributed. Suggest an efficient algorithm to find the most reliable path between a given source node and the destination nodes. (10 Marks)

14. Define Vertex-cover problem. Show that vertex cover problem is NP-complete. (4+6 Marks)

15. Compute all pair shortest path for the given graph (10 Marks)



$$D(0) = \begin{bmatrix} 0 & 3 & 8 & \infty & -4 \\ \infty & 0 & \infty & 1 & 7 \\ \infty & 4 & 0 & \infty & \infty \\ 2 & \infty & -5 & 0 & \infty \\ \infty & \infty & \infty & 6 & 0 \end{bmatrix}$$

$$P(0) = \begin{bmatrix} nil & 1 & 1 & nil & 1 \\ nil & nil & nil & 2 & 2 \\ nil & 3 & nil & nil & nil \\ 4 & nil & 4 & nil & nil \\ nil & nil & nil & 5 & nil \end{bmatrix}$$