End-Semester Lab. Examination, May-2025

Algorithms Analysis & Design-2 (CSE 2632)

Programme: B.Tech.(CSE/CSIT/CIOT/CDS/CAIML/CCS)   **Sem: 4th**

Full Marks: 15

Time: 60 Mins.

SET-L

All questions are compulsory.

Q1. Given a directed graph G (V, E), write a JAVA program to detect whether the graph contains any cycle using the DFS algorithm.

Testcase:
Input: V = {0, 1, 2, 3}, E = {0→1, 1→2, 2→0, 2→3}
Output: The graph contains a cycle.

Q2. You are helping a librarian organize a new collection of books by their unique accession numbers. The librarian wants them arranged in ascending order as quickly as possible before the library opens. You decide to use a sorting algorithm based on the divide and conquer technique capable of sorting efficiently in O (n log n). Write a JAVA program that takes the list of accession numbers and sorts them.

Test case:
Input: [1023, 501, 1432, 876, 342]
Output: Sorted Accession Numbers: [342, 501, 876, 1023, 1432]

****End of Questions****

Instructions:
The evaluation scheme will be done in the following ways for a total mark of 7.5:
- Correct implementation with satisfactory response to questions: 7.5/7.5
- Correct implementation with unsatisfactory response to questions: 6/7.5
- Partial (min 50%) implementation with satisfactory response to questions: 4.5/7.5
- Partial (min 50%) implementation with unsatisfactory response to questions: 3/7.5
- No implementation and few responses to questions: 1.5/7.5
- No implementation and no responses to questions: 0/7.5
- Plagiarised code: 0/7.5

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Full Marks: 15   **Time: 60 Mins.**

SET-A

All questions are compulsory.

Q1. Let G(V, E) be an undirected graph with |V|=n and |E|=m. Write a program to determine the distance from vertex u to vertex to v, where u and v are any arbitrary source and destination vertices respectively of G. And also represent the graph in adjacency list representation.

Test case:
Input: V={a, b, c, d, e, f, g, h}, E={(a, b), (b, c), (a, c), (c, f), (f, a), (d, e), (e, h), (f, g), (g, d)}
Output: One possible path a to h is a-c-f-g-d-e-h. (Answer may not unique.)
Adjacency list is:
a->b->c->f   b->a->c   c->b->a->f   d->e->g e->d->h   f->g->c->a   g->f->d   h->e

Q2. You are working as a software developer for a logistics company that handles international shipments. Every day, the system receives a list of package weights that need to be loaded into containers in strictly increasing order to optimize balance and space. The operations team noticed that the current system, which uses a basic sorting method, becomes very slow when handling large batches of packages (sometimes with over 100,000 entries). They have asked you to write an efficient sorting algorithm that performs well in average cases and avoids excessive memory usage.

Your task is to write a program that takes in a list of package weights and returns the sorted list in ascending order. The solution must be efficient for large inputs, ideally using a divide-and-conquer strategy that minimizes additional memory usage and average-case time complexity.

Test Case:
Input: 45 12 78 23 56 89 12 33
Output: 12 12 23 33 45 56 78 89.

****End of Questions****

Instructions:
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- Partial (min 50%) implementation with satisfactory response to questions: 4.5/7.5
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- No implementation and few responses to questions: 1.5/7.5
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- Plagiarised code: 0/7.5

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Full Marks: 15   Time: 60 Mins.

SET-C

All questions are compulsory.

Q1. Given an undirected graph G (V, E) with |V|=n vertices and |E=m edges. Write a program to decide whether the graph is connected or not using the BFS algorithm.

Test Case:
Input: V= {a, b, c, d, e, f, g, h}, E= {a-b, b-c, a-c, c-f, f-a, d-e, e-h, f-g}
Output: The graph is not connected.

Q2. You are given a string of uppercase letters without repetition. Write an efficient program to find out how many letters violate the ascending order of alphabetical order.

Test case:
Input: APLE   Output: 2 **Explanation:** P is expected to the right of L, and L is expected to the right of E. Hence 2 letters P and L are violating the ascending order of alphabetical order.
Input: GREAT Output: 2 **Explanation:** G is expected to the right of E and A, R is expected to the right of E and A, E is expected to the right of A. Hence 3 letters G, R, and E are violating the ascending order of alphabetical order.

****End of Questions****

Instructions:
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- Correct implementation with unsatisfactory response to questions: 6/7.5
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4 to 6

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Full Marks: 15   **Time: 60 Mins.**

SET-(P)

All questions are compulsory.

Q1. Given a directed graph G (V, E) with a source vertex u and destination vertex v, write a program to find all possible paths from u to v using DFS.

Test case:
Input: V = {0,1,2,3}, E = {0-1, 1-2, 1-3, 2-3}, $u = 0$, $v = 3$
Output: [0-1-2-3], [0-1-3]
Explanation: There are two ways to reach at 3 from 0. These are: 0 -> 1 -> 3 and 0 -> 1 -> 2 -> 3.

Q2. Given two sorted arrays a[ ] and b[ ] of sizes m and n respectively, write a program to find the element that would be at the k-th position in the final sorted array formed by merging these two arrays.

Test case:
Input: a[ ] = [2, 3, 6, 7, 9], b[ ] = [1, 4, 8, 10], k = 5
Output: 6
Explanation: The final sorted array is [1, 2, 3, 4, 6, 7, 8, 9, 10]. The 5th element is 6.

****End of Questions****

Instructions:
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- Plagiarised code: 0/7.5