

End-Semester Lab. Examination, Jan-2025

Algorithms Analysis & Design-1 (CSE 2631)

Programme: B.Tech. (CSE/CSIT/CIOT/CS/AIML)

Sem: 3rd

Full Marks: 15

Time: 90 Mins.

All questions are compulsory.

Q1. To keep track of the books currently borrowed by members, maintain an array of book IDs. Each book ID is a unique identifier assigned to a book in the library. Write a Java program to perform the following tasks: 1) Count and return the number of unique book IDs in the array. 2) Find and return the number of times the most borrowed book ID appears in the array. **Example Input:** int[] borrowedBooks = {101, 102, 101, 104, 103, 104, 105, 105}; **Expected Output:**
Total unique books borrowed: 5
Most borrowed book count: 3

Q2. A library maintains a catalogue of books. The catalogue is represented as an array of Book objects. Each Book object contains: title (String), author (String), isAvailable (boolean): The availability status of the book. Write a Java program that allows users to search for books by entering either the book title or the author's name. The program should return a list of matching books and their availability status. **Example Input:** Book[] catalog = {new Book("To Kill a Mockingbird", "Harper Lee", true), new Book("1984", "George Orwell", false)};
String searchQuery = "George Orwell";
Expected Output: Matching books: Title: 1984, Author: George Orwell, Available: No

Q3. In a restaurant, customers are attended to in the order they arrive. A linked list maintains the customer arrival order. Create a Customer class with a) id (int): A unique identifier for the customer, and b) name (String): The name of the customer. Write a java program that performs the following operations: 1) Add a customer to the linked list, 2) Remove a customer from the linked list once they have been attended, 3) Display the current linked list status, and 4) Remove a customer from the linked list.

****End of Questions****

Instructions:

The evaluation will be done in the following ways:

- Correct implementation with satisfactory to on-spot questions: 5/5
- Correct implementation with unsatisfactory to on-spot questions: 3/5
- Incorrect/partial (min 80%) implementation with unsatisfactory to on-spot questions: 2/5
- Implementation with satisfactory to on-spot questions: 1/5

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Q1. A group of adventurers is on a treasure hunt in a mysterious forest. The forest is divided into N zones, numbered from 1 to N. Each zone contains a certain number of treasure coins (positive) or penalty coins (negative), represented in an array coins[], where coins[i] is the number of coins in zone i. The adventurers can start at any zone but must collect either treasure or penalty coins from consecutive zones only. Given this problem, write a program in JAVA that finds the maximum number of coins they can collect in one trip.

Sample Input: N=6, coins = [2, 4, -6, 8, 1, -5]

Sample Output: Maximum Coins: 9

Q2. A university library is managing its collection of books. The librarian wants to organize and search for books efficiently. Each book in the library is identified by a unique Book ID. The librarian has two tasks: Sort the Book IDs in ascending order to organize the library catalogue and Search for a specific Book ID to check its availability. Write a program in JAVA to help the librarian to sort the given array of Book IDs and search for a specific Book ID using binary search and indicates whether it is available or not.

Sample Input: N = 6, BookIDs = [105, 12, 75, 300, 50, 200], BookID to Search: 125

Sample Output: Sorted Book IDs: [12 50 75 105 200 300], Book Not Found

Q3. A company uses a linked list to manage a list of tasks that employees need to complete. Each task has the following details: Task ID (unique identifier) and Status (whether the task is "Pending", "In Progress", or "Completed"). The company needs a program to perform the operations- Remove a task from the list by its Task ID and Update the status of a task (e.g., change it from "Pending" to "In Progress" or "Completed"). Write a JAVA program for the company for the given problem. Display list after each operation.

Sample Input: Sample list- [101, "Pending"] -> [102, "In Progress"] -> [103, "Completed"]

Operations- UpdateStatus [101, "Pending"] -> [102, "Completed"] and Remove [101]

Sample Output: After UpdateStatus: [101, "Pending"] -> [102, "Completed"] -> [103, "Completed"]

After Remove: [102, "Completed"] -> [103, "Completed"]

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- No implementation with satisfactory to on-spot questions: 1/5
- Plagiarized code: -2.5/5

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Q1. During a security guard interview, each candidate's height is measured against a standard height "h." A value that indicates the deviation from the standard height, either 0(the same) or a +ve (more than standard) or -ve (less than standard), is retained for subsequent processing. Which height is most common? (h and all deviation values are considered as integers).

Case Study: For 15 candidates with standard height h=6, the list showing deviation in height is {1, 0, -1, -2, 1, 2, 2, 1, 1, -1, 1, 0, -1, -1, 1}. The most common height is 7.

Q2. You are given a list of 'n' students with their names and total marks secured in the examination. Write a program to arrange them in non-increasing order of their marks and decide if a unique or joint topper exists. Display the name of the topper/toppers.

Test case 1: Input						Test case 1: Output					
Name and Marks of 6 students						Unique topper: Shreya					
Vineet	Shreya	Vishal	Kamath	Rabin	Sandy	Shreya	Kamath	Vineet	Rabin	Sandy	Vishal
275	312	195	275	235	205	312	275	275	235	205	195
Test case 2: Input						Test case 2: Output					
Name and Marks of 6 students						Joint toppers: Shreya and Rabin					
Vineet	Shreya	Vishal	Kamath	Rabin	Sandy	Shreya	Rabin	Kamath	Vineet	Sandy	Vishal
275	312	195	287	312	205	312	312	287	275	205	195

Q3. Two linked lists, 'A' and 'B', were given. A is expected to be a list of even numbers, and B is expected to be a list of odd numbers. But in the input, 'A' has one odd element, and 'B' has an even element. Write a program to create linked lists and a method to operate on these two lists to update them as expected.

Test case:**Input:** {A: 150->52->26->31->12->64} and {B: 23->100->7->17->3}.**Output:** {A: 150->52->26->100->12->64} and {B: 23->31->7->17->3}.******End of Questions********Instructions:**

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Q1. Write a Java program to identify the missing number in a sequence of integers ranging from 1 to n. The input will be an array of size (n-1), containing distinct integers from 1 to n with one number missing. The program should output the missing number.

Example: Input: Array = [1, 2, 4, 6, 3, 7, 8] Output: Missing number = 5

Q2. You are given a building with n floors and a special ball. When the ball dropped from a floor, the ball may either:

1. Break if dropped from a floor equal to or higher than a critical floor (F).
2. Remain intact if dropped from a floor below the critical floor (F).

Write a Java program to determine the critical floor (F) with a minimum number of drops.

Input: Number of floors (n): 100

Critical floor (F): 30th

Output: Total drops required: 7

Q3. You are given two singly linked lists: List1 and List2.

Write a Java function to insert List2 into List1 after the second element of List1. If List1 has less than two elements, append List2 at the end of List1.

Input:

List1 = 1 -> 2 -> 3 -> 4 -> NULL

List2 = 5 -> 6 -> NULL

Output:

1 -> 2 -> 5 -> 6 -> 3 -> 4 -> NULL

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Q1. There is an integer array A sorted in ascending order (with distinct values). Prior to being passed to your function, A is possibly rotated at an unknown pivot index k ($1 \leq k < \text{nums.length}$) such that the resulting array is $[\text{nums}[k], \text{nums}[k+1], \dots, \text{nums}[\text{n}-1], \text{nums}[0], \text{nums}[1], \dots, \text{nums}[\text{k}-1]]$ (0-indexed). For example, $[0,1,2,4,5,6,7]$ might be rotated at pivot index 3 and become $[4,5,6,7,0,1,2]$. Given the array A after the possible rotation and an integer target, return the index of target if it is in A, or -1 if it is not in A. You must write a java program with $O(\log n)$ runtime complexity.

Q2. Given an integer array A, move all 0's to the end of it while maintaining the relative order of the non-zero elements. Note that you must do this in-place without making a copy of the array. Write a java program to implement it. Example: Input: A = [0,1,0,3,12] Output: [1,3,12,0,0]

Q3. Given a linked list, swap every two adjacent nodes and return its head. You must solve the problem without modifying the values in the list's nodes (i.e., only nodes themselves may be changed). Given the head of a linked list, reverse the nodes of the list k at a time, and return the modified list. k is a positive integer and is less than or equal to the length of the linked list. If the number of nodes is not a multiple of k then left-out nodes, in the end, should remain as it is. You may not alter the values in the list's nodes, only nodes themselves may be changed. Write a java program to implement it. For example Input: head = [1,2,3,4,5], k = 2 Output: [2,1,4,3,5]

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Q1. Chef visited a grocery store for fresh supplies. There are N items in the store where the i^{th} item has a freshness value A_i and cost B_i . Chef has decided to purchase all the items having a freshness value greater than equal to X . Find the total cost of the groceries Chef buys.

Sample test case: Input: $N = 2$, $X = 20$, $A = [15, 67]$, $B = [10, 90]$

Output: 90 (**Explanation:** Item 2 has freshness value greater than equal to $X=20$. Thus, Chef buys item 2. The total cost is 90.)

Q2. We need to find the total number of steps need to make the current array of size N same as an array containing 1 to N numbers as elements. Each decrement or increment is counted as a step.

Sample test case: Input: $A = [8, 3, 2, 1, 9]$

Output: 8 (**Explanation:** As our target array is $[1, 2, 3, 4, 5]$, we already have 1, 2, and 3 in our array. We have 8 and 9 in place of 4 and 5, so if convert 8 to 4, and 9 to 5, we can achieve target array. Hence minimum increments/decrements required will be $(8-4)+(9-5)$ ways i.e. 8 steps.)

Q3. Given the head of a linked list, Find the number of critical points. (The starting and end are not considered critical points). Local minima or maxima are called critical points. A Node is called a local minima if both next and previous elements are greater than the current element. A Node is called a local maxima if both next and previous elements are smaller than the current element.

Sample test case: Input: $L = [1, 2, 3, 2, 1, 3, 2]$

Output: 3 (**Explanation:** 3rd node, 5th node and 6th node are the critical nodes, hence the answer is 3)

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