Department of Computing and Information System
Mid-Term Semester Project: Spring-2025
Program: B.Sc. in CIS
Course Code: CIS 122 and CIS 122L
Course Title: Data Structure with Lab

Total Marks: 60

[Instructions: Give clear and concise answers for every task. Use examples if necessary]

Scenario

The **Data Structure** course is a fundamental subject in computer science designed to teach students how to efficiently organize, manage, and process data. It covers a range of essential data structures, including arrays, linked lists, stacks, queues, trees, and graphs, each playing a crucial role in solving complex computational problems. Understanding these structures enables students to choose the appropriate tool for a given task, optimizing both algorithm speed and memory usage.

Before the mid-term examination of the Spring 2025 semester, **Mr. Mehedi**, the course instructor for Data Structure (DS), delivered lectures on various topics. These included basic data structures, types and operations of data structures, arrays (insertion, deletion, updating, splitting, and merging), stacks, and queues. Additionally, he covered different searching algorithms, such as linear search and binary search. Following the mid-term examination, **Mr. Mehedi** will continue with lectures on linked lists, graphs, trees, and various sorting algorithms. Furthermore, a group of students has successfully completed the following tasks.

Task-1

In the fiscal year 2024–2025, the ICT Division of the People's Republic of Bangladesh will receive a limited number of projects from the CIS Department of Daffodil International University. **Mr. Sisir** plans to develop a project for an online ticket booking system for both buses and trains. Meanwhile, **Mr. Tusher**

aims to create a music playlist application. All projects will be completed and presented to the ICT Division within four months.

Task-2

In April 2025, the Department of Computing and Information Systems (CIS) at DIU will organize a study tour to explore various historical sites across different districts of Bangladesh. The tour coordinator, **Mr. Mehedi**, has compiled a list of historical places in various districts along with the associated travel costs between each pair of locations. He then constructs a graph, shown in Figure 01, where the historical sites are represented as vertices and the travel costs as weighted edges. For example, vertices may represent sites such as Cox's Bazar, Rangamati, Saint Martin, Kuthibari, Sajek Valley, and Ahsan Manzil, while the edges indicate the cost of traveling between them. Once the graph is finalized, **Mr. Mehedi** will meet with the head of the department to discuss tour-related matters. Additionally, he will hold a meeting with all students to present the final graph and provide details about the tour.

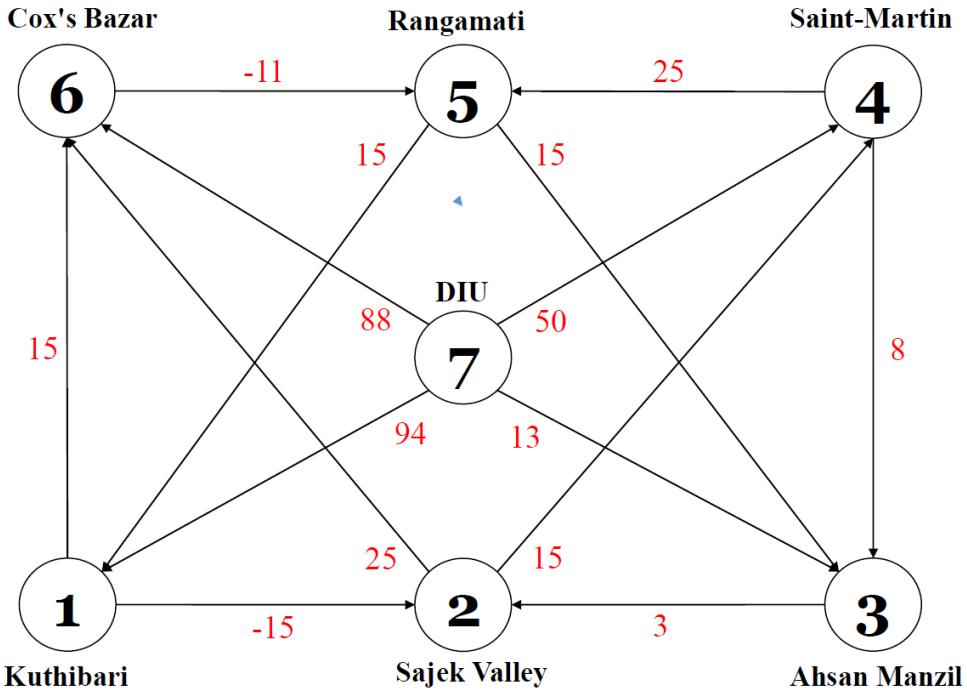

Figure 01: Directed graph

Task-3

After the Mid-Term, the course instructor made a unique statement about the tree data structure. One of the statements was as follows:

"Suppose you randomly select 10 distinct integer numbers between 20 and 200, where the first, fourth, seventh, and ninth numbers are 26, XX, 86, and 52, respectively [XX = (the last two digits of your Student ID % 10) + the lowest number you select]. Additionally, only two numbers are less than 35, and no more than four numbers exceed 110." After stating this, the instructor presented the following challenge.

Draw the Binary Search Tree (BST) and explain how binary search is applicable to find your Student ID?

In the classroom, all the students began to solve the given challenge. After some time, the course instructor noticed that one of the students, **Mr. Arif** successfully solved the challenge, while **Mr. Habib** successfully built a BST but encountered difficulties in finding his Student ID. Eventually, **Mr. Arif** helped him overcome these difficulties.

Task-4

One day, the course instructor of DS conducted an interesting topic about Single Linked List. After that, all the students know how to insert and delete operations from the mentioned linked list. Then **Mr. Mehedi** drew the following diagram on the basis of lecture and through some questions to the students.

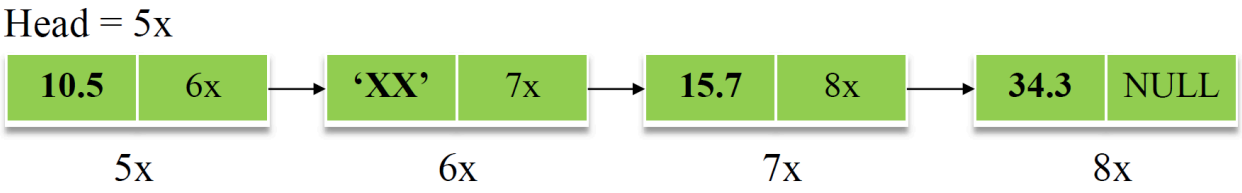

Figure 02: Single linked list

QA. Write the pseudocode to delete 'XX' from the linked list based on the given scenario [**'XX'** = (Your SGPA from the last semester)+3.21].

QB. Is it possible to display the elements (see **Figure 02**) in reverse order? If **yes**, please explain how this can be achieved with a proper explanation. If **no**, please justify your reasoning.

All the students are hardly trying to solve the question that is provided by **Mr. Mehedi**. Almost all students failed to provide the correct answer. But, finally a student let's say **Mr. Tamim** successfully solved the problem.

Theory Part (marks - 35)

Task-1 Marks - 15

Q1. Which type of data structure are used by **Mr. Sisir** and **Mr. Tusher**? Describe with proper explanation based on the scenario. [4] [CLO 1]

Q2. Prove that the adjacency matrix in **Figure 01** is asymmetric. [3] [CLO 3]

Q3. How does **Mr. Arif** solve the challenge provided by the course instructor? A detailed description is needed. [**5**][CLO 3]

Q4. How did **Mr. Arif** solve the difficulties faced by **Mr. Habib**? Describe with proper explanation. [3][CLO 3]

Task-2 Marks - 15

Q5. Find out the minimum travel cost from DIU to **X** of **Figure 01** that is made by **Mr. Mehedi**. [**X**= (last two digits of your student ID%6)+1] [4][CLO 3]

Q6. How do you determine the chromatic number of **Figure 01**? A detailed explanation is required. [3][CLO 3]

Q7. How did **Mr. Tamim** solves the QA and QB? Elaborately described with necessary explanation. [4+4] [CLO 3]

Task-3 Marks - 5

Q8. Explain details about your theory work (Task-1 and Task-2) and make a short video (at least 4 minutes). [**5**] [CLO 4]

Lab Part (marks - 25)

Task-1 **Marks – 20**

QL1. Implement the mentioned BST using the c/c++ programming language that is made by **Mr. Arif**. [8] [CLO 4]

QL2. Implement the *QA* and *QB* using the c/c++ programming language that is made by **Mr. Tamim**. [6+6] [CLO 4]

Task-2 **Marks – 5**

QL3. Explain details about your lab work (Task-1) and make a short video (at least 4 minutes). [**5**] [CLO 4]

General Instructions

- **Deadline:** 10th April, 2025
- You have to submit the assignment in .docx or .pdf format (name it with your ID, such as 242-16-XXX.pdf), **Zip the file if any supplementary files are needed**.
- Submit the assignment in the **BLC Assignment section** and **Google Classroom**, the option of submission will be available there very soon.
- Deadline is fixed, no excuse will be considered if you missed the deadline.
- Marks will be deducted accordingly if any plagiarism of work is provided.

You must submit the hardcopy of the semester project on the Final Viva day. If anyone is missing at the viva, marks will be deducted.