Data Structures

BS (CS) _Fall_2024

Lab_07 Tasks

Learning Objectives:

1. Doubly Linked List
2. Circular Linked List

Lab Tasks

Question 1

Design a doubly linked list class with the following specifications:

1. DoublyNode Class:

    - Create a class called `DoublyNode` with the following data members:

        - int data to store the data for the node.
        - DoublyNode* prev to store a pointer to the previous node.
        - DoublyNode* next to store a pointer to the next node.

    - Provide the following member functions:

        - A default constructor for `DoublyNode.
        - A parameterized constructor that sets the data, prev, and next pointers.
        - Getter methods for data, prev, and next.
        - Setter methods for data, prev, and next.

2. DoublyLinkedList Class:

    - Create a class called `DoublyLinkedList` to manage a doubly linked list. It should have a pointer to the head node initially.

    - Provide the following member functions:

        - A default constructor for DoublyLinkedList.

        - A function called `insert` to insert a data item at the end of the doubly linked list. If the list is empty, the new node becomes the head.

- A function called insertToHead to insert a data element at the beginning of the doubly linked list.
- A function called isEmpty to check if the doubly linked list is empty.
- Explain why there is no need to implement an `isFull` function.
- A function called `search` to search for a specific element provided by the user and return true if found, false otherwise.
- A function called `update` to update/replace one data element with another.
- A function called `insertAtIndex` that will count the data elements in the doubly linked list and place a new data element in the specified location (indexed by counting from 0).
- A function called `deleteData` to delete a specified data element. This should involve updating the previous node's `next` pointer and the next node's `prev` pointer accordingly.
- A function called `print` to print the data of the doubly linked list from the head to the end.

Your task is to implement both the `DoublyNode` and `DoublyLinkedList` classes based on the provided specifications and ensure that they work correctly as described.

Question 2

The Josephus problem is the following game: N people, numbered 1 to N, are sitting in a circle. Starting at person 1, a hot potato is passed. After M passes, the person holding the hot potato is eliminated, the circle closes ranks, and the game continues with the person who was sitting after the eliminated person picking up the hot potato. The last remaining person wins. Thus, if M = 0 and N = 5, players are eliminated in order, and player 5 wins. If M = 1 and N = 5, the order of elimination is 2, 4, 1, 5.

Write a program to solve the Josephus problem using a circular linked list for general values of M and N. Try to make your program as efficient as possible. Make sure you dispose of cells.

Input	**Output**
M=2, N=6	1
M=1, N=5	3
M=3, N=9	1