COMSATS University Islamabad, Vehari Campus

Department of Computer Science

Class: BCS-SP22 **Submission Deadline: 9 Oct 2023**

Subject: Data Structures and Algorithms-Lab **Instructor: Yasmeen Jana**

Max Marks: 20 **Reg. No: SP22-BCS-031/Mahreeba**

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You can ask queries related to Lab Activities on the above email.

Activity 1:

```
#include <iostream>
using namespace std;

class Node {
public:
   int data;
   Node* next;

   Node(int value) {
      data = value;
      next = nullptr;
```

```
    }
};

class LinkedList {
private:
    Node* head;

public:
    LinkedList() {
        head = nullptr;
    }

    // Function to add a node at the end of the list
    void insertAtEnd(int value) {
        Node* newNode = new Node(value);
        if (head == nullptr) {
            head = newNode;
        } else {
            Node* current = head;
            while (current->next != nullptr) {
                current = current->next;
            }
            current->next = newNode;
        }
    }

    // Function to add a node at the beginning of the list
    void insertAtStart(int value) {
        Node* newNode = new Node(value);
```

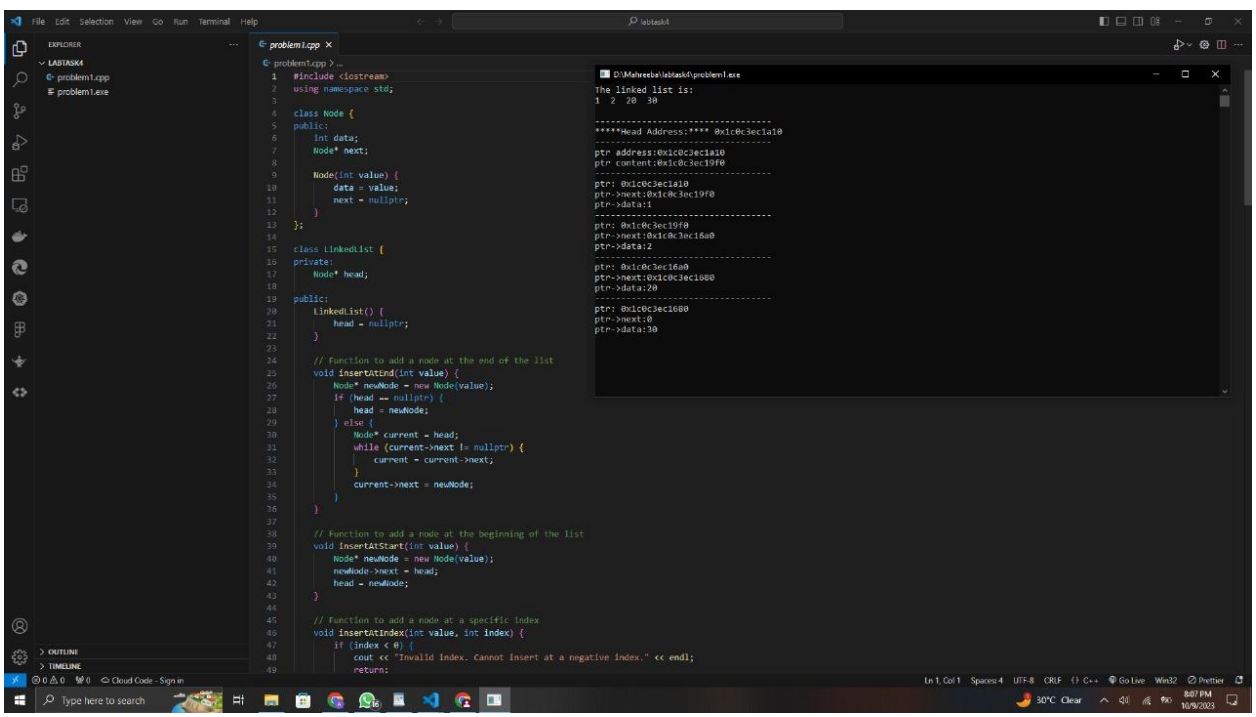
```
    newNode->next = head;
    head = newNode;
}

// Function to add a node at a specific index
void insertAtIndex(int value, int index) {
    if (index < 0) {
        cout << "Invalid index. Cannot insert at a negative index." << endl;
        return;
    }

    Node* newNode = new Node(value);
    if (index == 0) {
        newNode->next = head;
        head = newNode;
    } else {
        Node* current = head;
        int currentIndex = 0;
        while (current != nullptr && currentIndex < index - 1) {
            current = current->next;
            currentIndex++;
        }
        if (current == nullptr) {
            cout << "Invalid index. Cannot insert at the specified index." << endl;
            return;
        }
        newNode->next = current->next;
        current->next = newNode;
    }
```

```
}

// Function to delete a node at a specific index
void deleteAtIndex(int index) {
    if (index < 0) {
        cout << "Invalid index. Cannot delete at a negative index." << endl;
        return;
    }

    if (head == nullptr) {
        cout << "List is empty. Cannot delete from an empty list." << endl;
        return;
    }

    if (index == 0) {
        Node* temp = head;
        head = head->next;
        delete temp;
    } else {
        Node* current = head;
        int currentIndex = 0;
        while (current->next != nullptr && currentIndex < index - 1) {
            current = current->next;
            currentIndex++;
        }
        if (current->next == nullptr) {
            cout << "Invalid index. Cannot delete at the specified index." << endl;
            return;
        }
```

```
        Node* temp = current->next;
        current->next = current->next->next;
        delete temp;
    }
}

//Function to del node at first
void deleteAtFirst(){
    Node * temp = head;
    head = (head->next);
    delete temp;
}

//Function to delete at end
void deleteAtEnd(){
    Node * temp=head;
    Node * newlast=temp;
    while (temp->next!= nullptr)
    {
        newlast= temp;
        temp = temp->next;
    }

    newlast->next= nullptr;
    delete temp;

}

// Function to print the entire linked list
```

```
    void printList() {
        cout<<"The linked list is:"<<endl;
        Node* current = head;
        while (current != nullptr) {
            cout << current->data << "  ";
            current = current->next;
        }
        cout<<"\n\n----------------------------------"<<endl;
        cout<<"****Head Address:*** " <<head<<endl;

        Node* ptr =head;
        cout<<"----------------------------------"<<endl;
        cout<<"ptr address:"<<ptr<<endl;
        cout<<"ptr content:"<<ptr->next<<endl;
        while(ptr != nullptr){
            cout<<"----------------------------------"<<endl;
            cout<<"ptr: "<<ptr<<endl;
            cout<<"ptr->next:"<<ptr->next<<endl;
            cout<<"ptr->data:"<<ptr->data<<endl;
            ptr= ptr->next;

        }




    }
};

int main() {
```

```
    LinkedList myList;



    myList.insertAtStart(30);
    myList.insertAtStart(20);
    myList.insertAtStart(2);
    myList.insertAtStart(1);


    myList.printList();
    getchar();
    return 0;
}
```



Activity 2:

Write a program that will implement single, doubly, and circular linked link list operations by showing a menu to the user.

The menu should be:

Which linked list you want:

1: Single

2: Double

3: Circular

After the option is chosen by the user:

Which operation you want to perform:

1: Insertion

2: Deletion

3: Display

4: Reverse

4: Seek

5: Exit

Let's suppose, the user has chosen the insertion option then the following menu should be displayed:

1: insertion at beginning

2: insertion at end

3: insertion at the specific data node

A sample output screenshot is below:

Solution:

```
#include <iostream>

using namespace std;


// Node for linked lists

struct Node {
```

```
    int data;
    Node* next;
    Node* prev;
};

class LinkedList {
private:
    Node* head;
    Node* tail;
public:
    LinkedList() {
        head = nullptr;
        tail = nullptr;
    }

    // Function for insertion
    void insertAtBeginning(int value) {
        Node* newNode = new Node;
        newNode->data = value;
        newNode->next = head;
        newNode->prev = nullptr;

        if (head != nullptr) {
            head->prev = newNode;
        }

        head = newNode;

        if (tail == nullptr) {
```

```
        tail = newNode;
    }
}

// Function for insertion at end
void insertAtEnd(int value) {
    Node* newNode = new Node;
    newNode->data = value;
    newNode->next = nullptr;

    if (tail != nullptr) {
        tail->next = newNode;
        newNode->prev = tail;
    }

    tail = newNode;

    if (head == nullptr) {
        head = newNode;
    }
}

// Function to insert at specific location
void insertAfter(int target, int value) {
    Node* newNode = new Node;
    newNode->data = value;

    Node* current = head;
```

```
    while (current != nullptr && current->data != target) {
        current = current->next;
    }

    if (current != nullptr) {
        newNode->next = current->next;
        current->next = newNode;
        newNode->prev = current;

        if (newNode->next != nullptr) {
            newNode->next->prev = newNode;
        }

        if (current == tail) {
            tail = newNode;
        }
    }
}

// Function for deletion of data
void deleteNode(int value) {
    Node* current = head;
    Node* previous = nullptr;

    while (current != nullptr && current->data != value) {
        previous = current;
        current = current->next;
    }
```

```
    if (current != nullptr) {
        if (previous != nullptr) {
            previous->next = current->next;
        } else {
            head = current->next;
        }

        if (current == tail) {
            tail = previous;
        }

        delete current;
    }
}

// Function to print the list
void display() {
    Node* current = head;

    while (current != nullptr) {
        cout << current->data << " ";
        current = current->next;
    }

    cout << endl;
}

// Function to reverse the linked list
void reverse() {
```

```
        cout<<"\nReversing the list...."<<endl;
        Node* current = head;
        Node* prev = nullptr;
        Node* next = nullptr;

        while (current != nullptr) {
            next = current->next;
            current->next = prev;
            prev = current;
            current = next;
        }

        head = prev;
    }

    // Function to seek a specific data value
    bool seek(int value) {
        Node* current = head;

        while (current != nullptr) {
            if (current->data == value) {
                return true;
            }
            current = current->next;
        }

        return false;
    }
};
```

```
int main() {
    int choice, subChoice;
    LinkedList sList, dList, cList;
    int insertValue;

    do { //do fpr list selection operation
        cout << "Which linked list you want:\n"
            << "1: Single\n"
            << "2: Double\n"
            << "3: Circular\n"
            << "Select: ";
        cin >> choice;

        switch (choice) {
            case 1:
                do { //after selection of singly
                    cout << "Which operation you want to perform:\n"
                        << "1: Insertion\n"
                        << "2: Deletion\n"
                        << "3: Display\n"
                        << "4: Reverse\n"
                        << "5: Seek\n"
                        << "6: Exit\n"
                        << "Select: ";
                    cin >> subChoice;

                    switch (subChoice) {
                        case 1:
```

```
int typeofinsertion;
cout<<"1. Insertion at beigning\n"
   <<"2. Insertion at end\n"
   <<"3. Insertion at specific data value\n"
   <<"Chose your option: ";
cin>>typeofinsertion;
switch(typeofinsertion){
   case 1:
      cout << "Enter the value to insert: ";
      cin >> insertValue;
      sList.insertAtBeginning(insertValue);
      cout<<"\n Items in list: ";
      sList.display();
      break;
   case 2:
      cout << "Enter the value to insert: ";
      cin >> insertValue;
      sList.insertAtEnd(insertValue);
      cout<<"\n Items in list: ";
      sList.display();
      break;
   case 3:
      int targetval;
      cout << "Enter the value to insert: ";
      cin >> insertValue;
      cout<<"ENter the value where you want to insert: ";
      cin>>targetval;
      sList.insertAfter(targetval,insertValue);
      cout<<"\n Items in list: ";
```

```
            sList.display();
            break;
        default:
            cout<<"You didn't selected appropiate option"<<endl;
            break;
    }
    break;
case 2:
    int deleteValue;
    cout << "Enter the value to delete: ";
    cin >> deleteValue;
    sList.deleteNode(deleteValue);
    break;
case 3:
    cout << "Single Linked List: ";
    sList.display();
    break;
case 4:
    sList.reverse();
    break;
case 5:
    int seekValue;
    cout << "Enter the value to seek: ";
    cin >> seekValue;
    if (sList.seek(seekValue)) {
        cout << "Value found in Single Linked List.\n";
    } else {
        cout << "Value not found in Single Linked List.\n";
    }
```

```
            break;
        case 6:
            cout << "Exiting Single Linked List menu.\n";
            break;
        default:
            cout << "Invalid choice. Please try again.\n";
            break;
    }
  } while (subChoice != 6);
  break;

case 2:
  do { //after slection of doubly
    cout << "Which operation you want to perform:\n"
        << "1: Insertion\n"
        << "2: Deletion\n"
        << "3: Display\n"
        << "4: Reverse\n"
        << "5: Seek\n"
        << "6: Exit\n"
        << "Enter your choice : ";
    cin >> subChoice;

    switch (subChoice) {
        case 1:

            int typeofinsertion;
            cout<<"1. Insertion at beigning\n"
                <<"2. Insertion at end\n"
```

```
    <<"3. Insertion at specific data value\n"
    <<"Chose your option: ";
cin>>typeofinsertion;
switch(typeofinsertion){
    case 1:
        cout << "Enter the value to insert: ";
        cin >> insertValue;
        dList.insertAtBeginning(insertValue);
        cout<<"\n Items in list: ";
        dList.display();
        break;
    case 2:
        cout << "Enter the value to insert: ";
        cin >> insertValue;
        dList.insertAtEnd(insertValue);
        cout<<"\n Items in list: ";
        dList.display();
        break;
    case 3:
        int targetval;
        cout << "Enter the value to insert: ";
        cin >> insertValue;
        cout<<"ENter the value where you want to insert: ";
        cin>>targetval;
        dList.insertAfter(targetval,insertValue);
        cout<<"\n Items in list: ";
        dList.display();
        break;
    default:
```

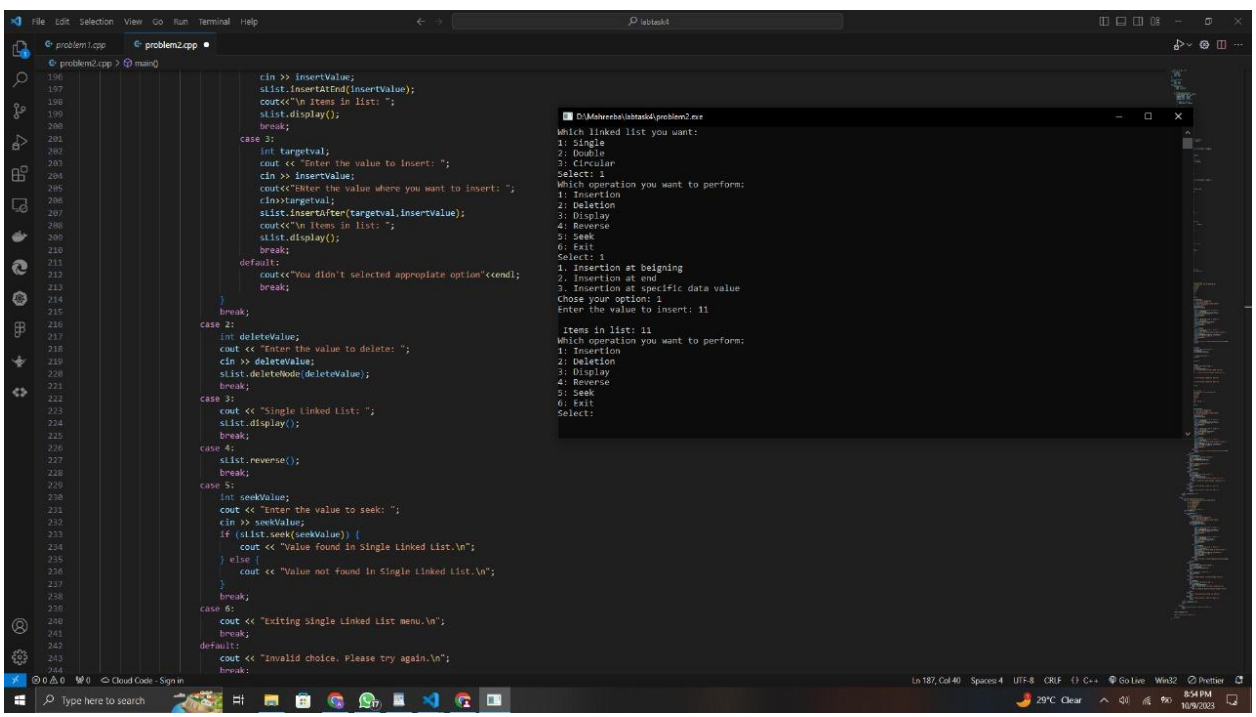
```
            cout<<"You didn't selected appropiate option"<<endl;
            break;
        }break;
    case 2:
        int deleteValue;
        cout << "Enter the value to delete: ";
        cin >> deleteValue;
        dList.deleteNode(deleteValue);
        break;
    case 3:
        cout << "Double Linked List: ";
        dList.display();
        break;
    case 4:
        dList.reverse();
        break;
    case 5:
        int seekValue;
        cout << "Enter the value to seek: ";
        cin >> seekValue;
        if (dList.seek(seekValue)) {
            cout << "Value found in Double Linked List.\n";
        } else {
            cout << "Value not found in Double Linked List.\n";
        }
        break;
    case 6:
        cout << "Exiting Double Linked List menu.\n";
        break;
```

```
            default:
                cout << "Invalid choice. Please try again.\n";
                break;
        }
    } while (subChoice != 6);
    break;

case 3:
    do { //after selection of circular
        cout << "Which operation you want to perform:\n"
            << "1: Insertion\n"
            << "2: Deletion\n"
            << "3: Display\n"
            << "4: Reverse\n"
            << "5: Seek\n"
            << "6: Exit\n"
            << "Enter your choice: ";
        cin >> subChoice;

        switch (subChoice) {
            case 1:
                int typeofinsertion;
                cout<<"1. Insertion at beigning\n"
                    <<"2. Insertion at end\n"
                    <<"3. Insertion at specific data value\n"
                    <<"Chose your option: ";
                cin>>typeofinsertion;
                switch(typeofinsertion){
                    case 1:
```

```
            cout << "Enter the value to insert: ";
            cin >> insertValue;
            cList.insertAtBeginning(insertValue);
            cout<<"\n Items in list: ";
            cList.display();
            break;
        case 2:
            cout << "Enter the value to insert: ";
            cin >> insertValue;
            cList.insertAtEnd(insertValue);
            cout<<"\n Items in list: ";
            cList.display();
            break;
        case 3:
            int targetval;
            cout << "Enter the value to insert: ";
            cin >> insertValue;
            cout<<"ENter the value where you want to insert: ";
            cin>>targetval;
            cList.insertAfter(targetval,insertValue);
            cout<<"\n Items in list: ";
            cList.display();
            break;
        default:
            cout<<"You didn't selected appropiate option"<<endl;
            break;
    }break;
case 2:
```

```
        int deleteValue;
        cout << "Enter the value to delete: ";
        cin >> deleteValue;
        cList.deleteNode(deleteValue);
        break;
    case 3:
        cout << "Circular Linked List: ";
        cList.display();
        break;
    case 4:
        cout << "Cannot reverse a circular linked list.\n";
        break;
    case 5:
        int seekValue;
        cout << "Enter the value to seek: ";
        cin >> seekValue;
        if (cList.seek(seekValue)) {
            cout << "Value found in Circular Linked List.\n";
        } else {
            cout << "Value not found in Circular Linked List.\n";
        }
        break;
    case 6:
        cout << "Exiting Circular Linked List menu.\n";
        break;
    default:
        cout << "Invalid choice. Please try again.\n";
        break;
}
```

```
            } while (subChoice != 6);
            break;

        default:
            cout << "Invalid choice. Please try again.\n";
            break;
    }

  } while (choice != 4);

  cout << "Exiting the program.\n";

  return 0;
}
```



You can get help from the below link:

https://github.com/programming-debug/Data-Structure-Lab/blob/main/Lab3/single-link%20list.cpp

In this Word file, you should place the code and its output screenshot.

After completing the activities, Upload the final pdf and cpp code files to the "**DSA_Lab"** repository.