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

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

Activity 1:

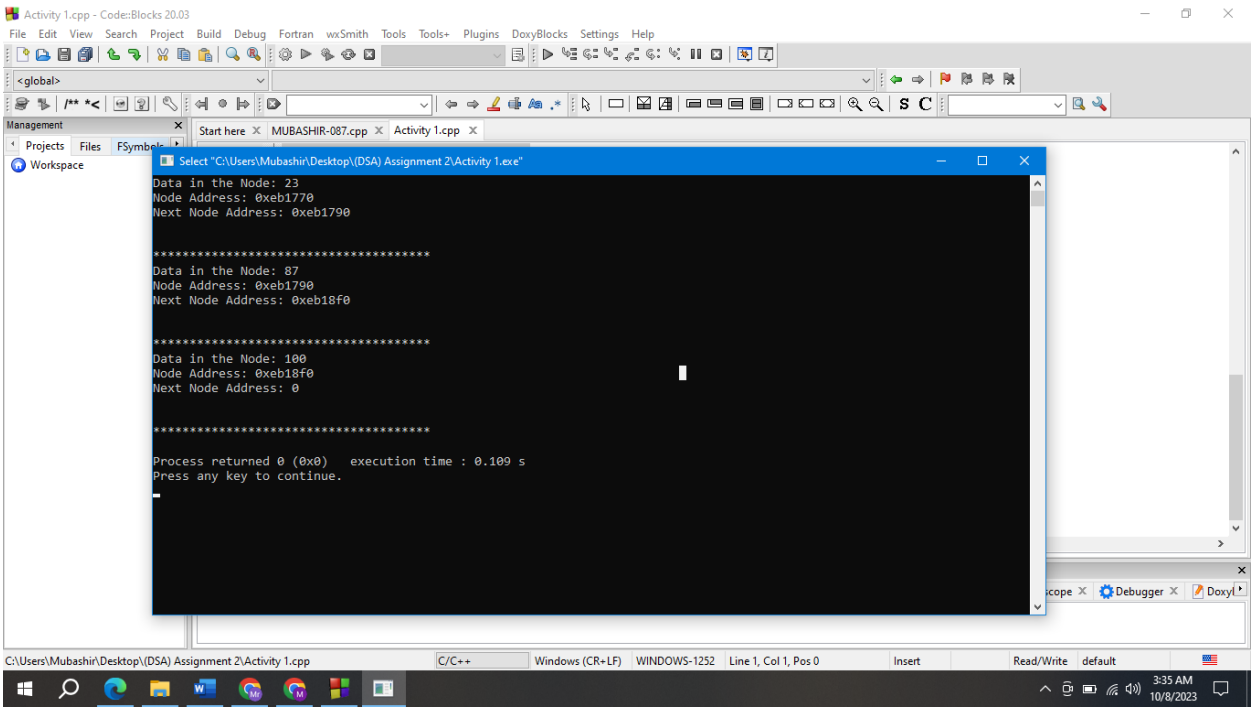
PROGRAM CODE

```
#include <iostream>
using namespace std;
class Node {
    public:
        int data;
        Node* next;

        Node(int val) {
```

```
            data = val;
            next = nullptr;
        }
};

class SinglyLinkedList {
    public:
        Node* head;

        SinglyLinkedList() {
            head = nullptr;
        }

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

```
        // Function to display the data, address, and next address of each node in the
linked list
        void display() {
            Node* current = head;
            while (current != nullptr) {
                cout << "Data in the Node: " << current->data << endl;
                cout << "Node Address: " << current << endl;
                cout << "Next Node Address: " << current->next << endl;
                cout << endl; // Add a blank line for separation
                current = current->next;
                cout<<"\n*************************************\n";
            }
        }

};

int main() {
    SinglyLinkedList myList;
    myList.Insert_Node(23);
    myList.Insert_Node(87);
    myList.Insert_Node(100);

    myList.display();

    return 0;
}
```

PROGRAM OUTPUT



Activity 2:

PROGRAM CODE

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

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

   Node(int val) {
      data = val;
      next = nullptr;
   }
};

class DoublyNode {
public:
   int data;
   DoublyNode* prev;
   DoublyNode* next;

   DoublyNode(int val) {
      data = val;
      prev = nullptr;
      next = nullptr;
   }
};
```

```
class CircularNode {
public:
    int data;
    CircularNode* next;

    CircularNode(int val) {
        data = val;
        next = nullptr;
    }
};

class SingleLinkedList {
public:
    Node* head;

    SingleLinkedList() {
        head = nullptr;
    }

    void insertAtBeginning(int val) {
        Node* newNode = new Node(val);
        newNode->next = head;
        head = newNode;
    }

    void insertAtEnd(int val) {
        Node* newNode = new Node(val);
        if (head == nullptr) {
```

```
        head = newNode;
        return;
    }
    Node* current = head;
    while (current->next != nullptr) {
        current = current->next;
    }
    current->next = newNode;
}

void insertAfterData(int val, int target) {
    Node* newNode = new Node(val);
    Node* current = head;
    while (current != nullptr && current->data != target) {
        current = current->next;
    }
    if (current == nullptr) {
        cout << "Target data not found in the list." << endl;
        return;
    }
    newNode->next = current->next;
    current->next = newNode;
}

void deleteNode(int val) {
    Node* current = head;
    Node* prev = nullptr;

    while (current != nullptr && current->data != val) {
```

```
        prev = current;
        current = current->next;
    }

    if (current == nullptr) {
        cout << "Data not found in the list." << endl;
        return;
    }

    if (prev == nullptr) {
        head = current->next;
    } else {
        prev->next = current->next;
    }

    delete current;
}

void reverse() {
    Node* prev = nullptr;
    Node* current = head;
    Node* next = nullptr;

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

```
        head = prev;
    }

    void display() {
        Node* current = head;
        while (current != nullptr) {
            cout << "Data: " << current->data << endl;
            cout << "Address: " << current << endl;
            cout << "Next Address: " << current->next << endl << endl;
            current = current->next;
        }
    }

    bool seek(int val) {
        Node* current = head;
        while (current != nullptr) {
            if (current->data == val) {
                return true;
            }
            current = current->next;
        }
        return false;
    }
};

class DoublyLinkedList {
public:
    DoublyNode* head;
```

```
DoublyLinkedList() {
    head = nullptr;
}

void insertAtBeginning(int val) {
    DoublyNode* newNode = new DoublyNode(val);
    newNode->next = head;
    newNode->prev = nullptr;
    if (head != nullptr) {
        head->prev = newNode;
    }
    head = newNode;
}

void insertAtEnd(int val) {
    DoublyNode* newNode = new DoublyNode(val);
    if (head == nullptr) {
        head = newNode;
        return;
    }
    DoublyNode* current = head;
    while (current->next != nullptr) {
        current = current->next;
    }
    current->next = newNode;
    newNode->prev = current;
}
```

```
void insertAfterData(int val, int target) {
    DoublyNode* newNode = new DoublyNode(val);
    DoublyNode* current = head;
    while (current != nullptr && current->data != target) {
        current = current->next;
    }
    if (current == nullptr) {
        cout << "Target data not found in the list." << endl;
        return;
    }
    newNode->next = current->next;
    newNode->prev = current;
    if (current->next != nullptr) {
        current->next->prev = newNode;
    }
    current->next = newNode;
}

void deleteNode(int val) {
    DoublyNode* current = head;

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

    if (current == nullptr) {
        cout << "Data not found in the list." << endl;
        return;
    }
```

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

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

    delete current;
}

void reverse() {
    DoublyNode* current = head;
    while (current != nullptr) {
        swap(current->next, current->prev);
        head = current;
        current = current->prev;
    }
}

void display() {
    DoublyNode* current = head;
    while (current != nullptr) {
        cout << "Data: " << current->data << endl;
        cout << "Address: " << current << endl;
        cout << "Next Address: " << current->next << endl;
```

```
            cout << "Prev Address: " << current->prev << endl << endl;
            current = current->next;
        }
    }

    bool seek(int val) {
        DoublyNode* current = head;
        while (current != nullptr) {
            if (current->data == val) {
                return true;
            }
            current = current->next;
        }
        return false;
    }
};

class CircularLinkedList {
public:
    CircularNode* head;

    CircularLinkedList() {
        head = nullptr;
    }

    void insertAtBeginning(int val) {
        CircularNode* newNode = new CircularNode(val);
        if (head == nullptr) {
            newNode->next = newNode;
```

```
    } else {
        CircularNode* current = head;
        while (current->next != head) {
            current = current->next;
        }
        current->next = newNode;
        newNode->next = head;
    }
    head = newNode;
}

void insertAtEnd(int val) {
    CircularNode* newNode = new CircularNode(val);
    if (head == nullptr) {
        newNode->next = newNode;
        head = newNode;
    } else {
        CircularNode* current = head;
        while (current->next != head) {
            current = current->next;
        }
        current->next = newNode;
        newNode->next = head;
    }
}

void insertAfterData(int val, int target) {
    CircularNode* newNode = new CircularNode(val);
    if (head == nullptr) {
```

```
        cout << "List is empty. Cannot insert after data." << endl;
        return;
    }
    CircularNode* current = head;
    while (current->data != target) {
        current = current->next;
        if (current == head) {
            cout << "Target data not found in the list." << endl;
            return;
        }
    }
    newNode->next = current->next;
    current->next = newNode;
}

void deleteNode(int val) {
    if (head == nullptr) {
        cout << "List is empty. Cannot delete data." << endl;
        return;
    }
    CircularNode* current = head;
    CircularNode* prev = nullptr;

    do {
        if (current->data == val) {
            if (prev == nullptr) {
                CircularNode* temp = head;
                while (temp->next != head) {
                    temp = temp->next;
```

```
            }
            head = head->next;
            temp->next = head;
            delete current;
            return;
        } else {
            prev->next = current->next;
            delete current;
            return;
        }
    }
    prev = current;
    current = current->next;
  } while (current != head);

  cout << "Data not found in the list." << endl;
}

void display() {
  if (head == nullptr) {
    cout << "List is empty." << endl;
    return;
  }
  CircularNode* current = head;
  do {
    cout << "Data: " << current->data << endl;
    cout << "Address: " << current << endl;
    cout << "Next Address: " << current->next << endl << endl;
    current = current->next;
```

```
        } while (current != head);
    }

    bool seek(int val) {
        if (head == nullptr) {
            return false;
        }
        CircularNode* current = head;
        do {
            if (current->data == val) {
                return true;
            }
            current = current->next;
        } while (current != head);
        return false;
    }
};

int main() {
    int choice;
    int listType;

    SingleLinkedList sll;
    DoublyLinkedList dll;
    CircularLinkedList cll;

    do {
        cout << "Which linked list you want:" << endl;
        cout << "1: Single" << endl;
```

```
cout << "2: Double" << endl;
cout << "3: Circular" << endl;
cout << "Enter your choice (1/2/3): ";
cin >> listType;

if (listType < 1 || listType > 3) {
   cout << "Invalid choice. Please enter a valid option (1/2/3)." << endl;
   continue;
}

cout << "Which operation you want to perform:" << endl;
cout << "1: Insertion" << endl;
cout << "2: Deletion" << endl;
cout << "3: Display" << endl;
cout << "4: Reverse" << endl;
cout << "5: Seek" << endl;
cout << "6: Exit" << endl;
cout << "Enter your choice (1/2/3/4/5/6): ";
cin >> choice;

switch (choice) {
   case 1: {
      int insertChoice;
      cout << "1: Insertion at beginning" << endl;
      cout << "2: Insertion at end" << endl;
      cout << "3: Insertion at a specific data node" << endl;
      cout << "Enter your choice (1/2/3): ";
      cin >> insertChoice;
      int data;
```

```
int targetData;
switch (insertChoice) {
   case 1:
      cout << "Enter data to insert: ";
      cin >> data;
      if (listType == 1) {
         sll.insertAtBeginning(data);
      } else if (listType == 2) {
         dll.insertAtBeginning(data);
      } else {
         cll.insertAtBeginning(data);
      }
      break;
   case 2:
      cout << "Enter data to insert: ";
      cin >> data;
      if (listType == 1) {
         sll.insertAtEnd(data);
      } else if (listType == 2) {
         dll.insertAtEnd(data);
      } else {
         cll.insertAtEnd(data);
      }
      break;
   case 3:
      cout << "Enter data to insert: ";
      cin >> data;
      cout << "Enter target data: ";
      cin >> targetData;
```

```
            if (listType == 1) {
                sll.insertAfterData(data, targetData);
            } else if (listType == 2) {
                dll.insertAfterData(data, targetData);
            } else {
                cll.insertAfterData(data, targetData);
            }
            break;
        default:
            cout << "Invalid choice. Please enter a valid option (1/2/3)." << endl;
            break;
    }
    break;
}
case 2: {
    int deleteData;
    cout << "Enter data to delete: ";
    cin >> deleteData;
    if (listType == 1) {
        sll.deleteNode(deleteData);
    } else if (listType == 2) {
        dll.deleteNode(deleteData);
    } else {
        cll.deleteNode(deleteData);
    }
    break;
}
case 3:
    cout << "Linked List Contents:" << endl;
```

```
    if (listType == 1) {
        sll.display();
    } else if (listType == 2) {
        dll.display();
    } else {
        cll.display();
    }
    break;
case 4:
    if (listType == 1) {
        sll.reverse();
    } else if (listType == 2) {
        dll.reverse();
    } else {
        cout << "Reverse operation not supported for Circular Linked List." << endl;
    }
    break;
case 5: {
    int seekData;
    cout << "Enter data to seek: ";
    cin >> seekData;
    bool found = false;
    if (listType == 1) {
        found = sll.seek(seekData);
    } else if (listType == 2) {
        found = dll.seek(seekData);
    } else {
        found = cll.seek(seekData);
    }
```

```
            if (found) {
                cout << "Data found in the list." << endl;
            } else {
                cout << "Data not found in the list." << endl;
            }
            break;
        }
        case 6:
            cout << "Exiting program." << endl;
            break;
        default:
            cout << "Invalid choice. Please enter a valid option (1/2/3/4/5/6)." << endl;
            break;
    }
} while (choice != 6);

return 0;
```

PROGRAM OUTPUT