Data Structures and Algorithms

Lab Assignment 3

SUBMITTED BY:

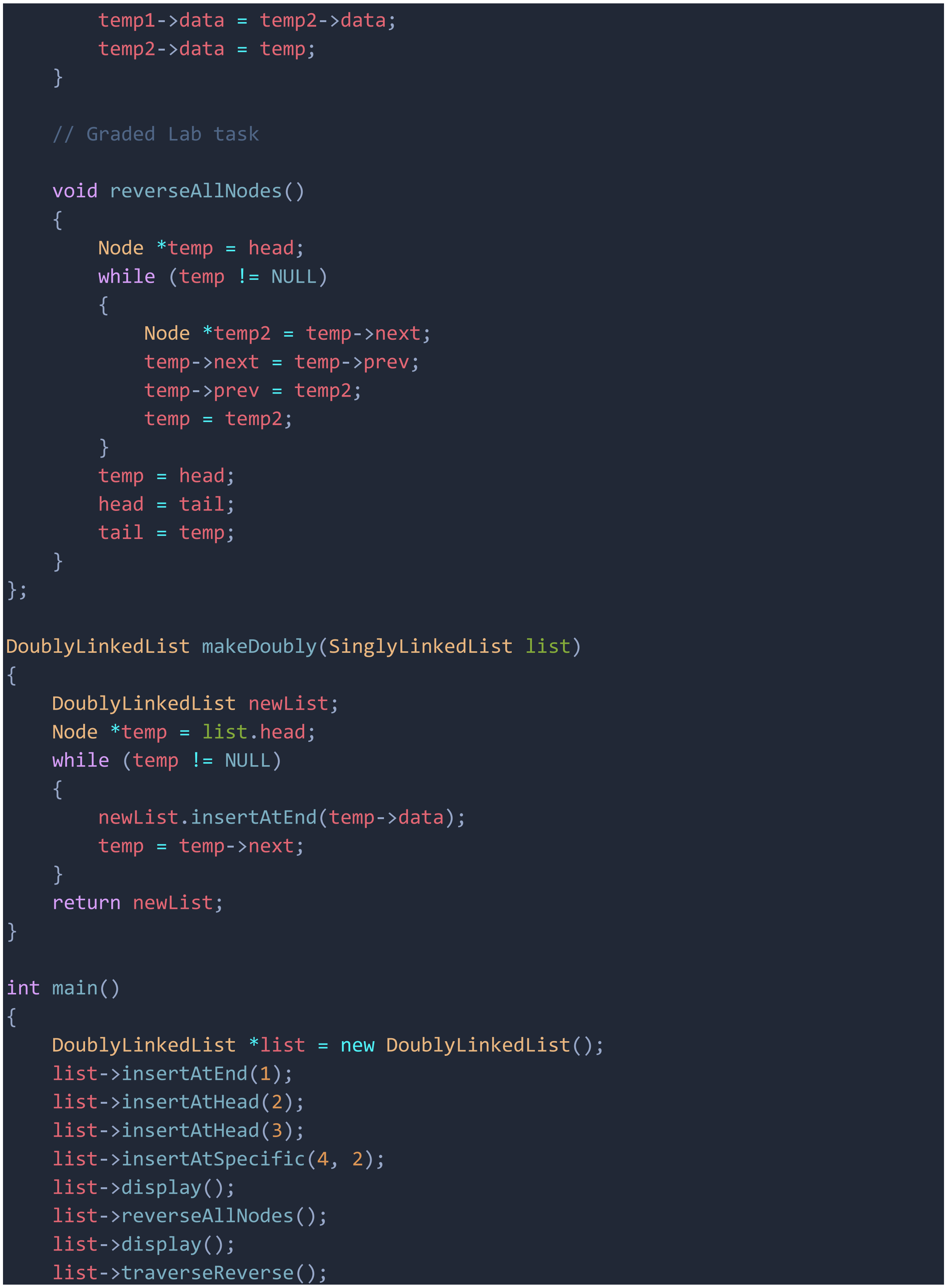
Hasaan Ahmad SP22-BSE-017

SUBMITTED TO: Sir Syed Ahmad Qasim

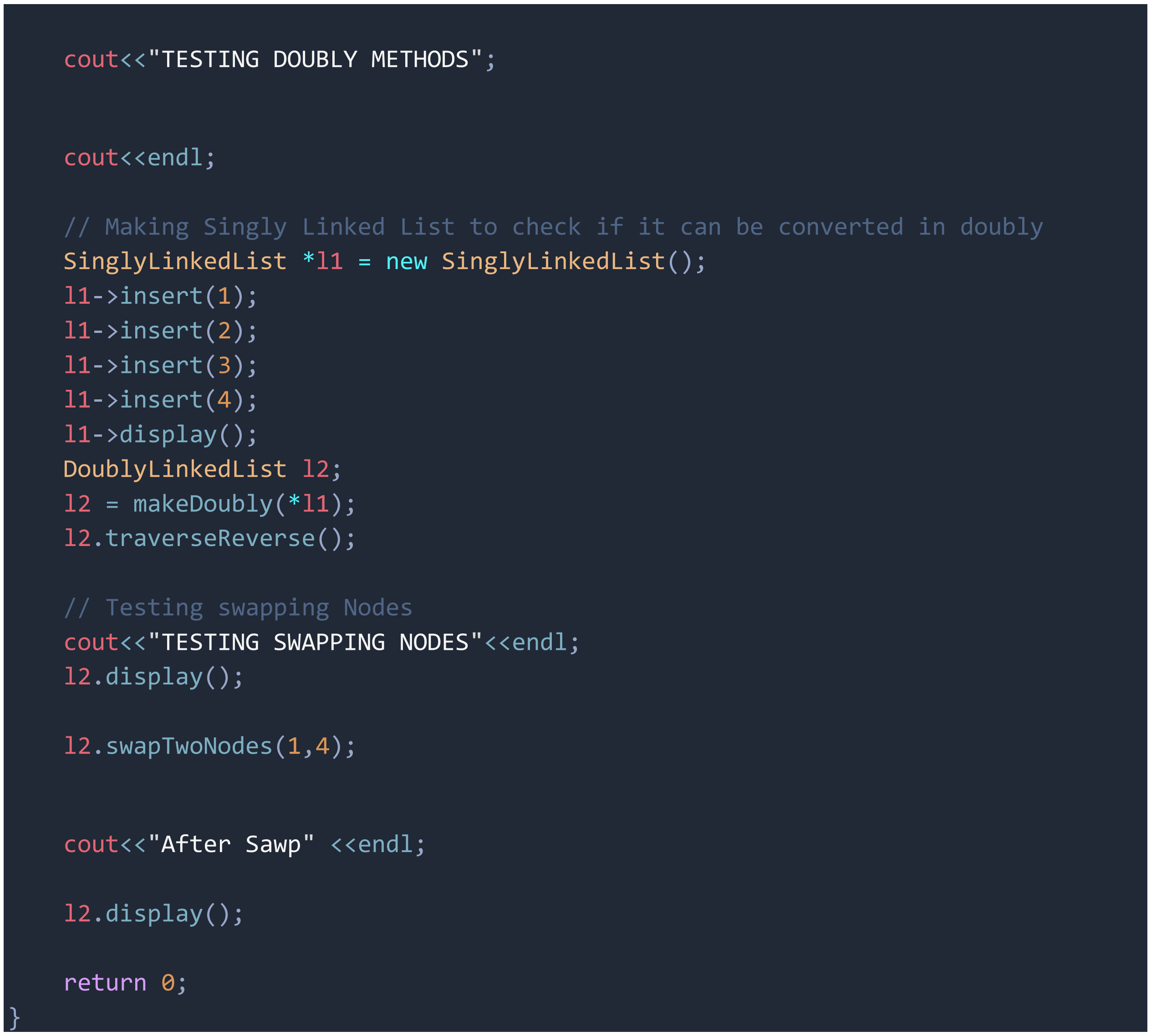
Code:

Code contains all the solved lab activities as well as graded lab tasks. Graded lab tasks are mentioned in comments of code.

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

class Node
{
public:
    int data;
    Node *next;
    Node *prev;
    Node(int val)
    {
        this->data = val;
        this->next = NULL;
        this->prev = NULL;
    }
};

// Graded Lab 3
class SinglyLinkedList
{
public:
    Node *head;
    SinglyLinkedList()
    {
        this->head = nullptr;
    }
    void insert(int val)
    {
        Node *newNode = new Node(val);
        if (head == nullptr)
        {
            head = newNode;
            return;
        }
        Node *temp = head;
        while (temp->next != nullptr)
        {
            temp = temp->next;
        }
        temp->next = newNode;
    }
    void display()
    {
        Node *temp = head;
        while (temp != nullptr)
        {
            cout << temp->data << " ";
            temp = temp->next;
        }
        cout << endl;
    }
};

class DoublyLinkedList
{
public:
    Node *head;
    Node *tail;
    DoublyLinkedList()
    {
        this->head = NULL;
        this->tail = NULL;
    }
    void insertAtEnd(int val)
    {
        Node *newNode = new Node(val);
        if (head == NULL)
        {
            head = newNode;
            tail = newNode;
            return;
        }
        tail->next = newNode;
        newNode->prev = tail;
        tail = newNode;
    }

    void insertAtHead(int val)
    {
        Node *newNode = new Node(val);
        if (head == NULL)
        {
            head = newNode;
            tail = newNode;
            return;
        }
        head->prev = newNode;
        newNode->next = head;
        head = newNode;
    }

    void insertAtSpecific(int val, int key)
    {
        Node *newNode = new Node(val);
        Node *temp = head;
        while (temp->data != key)
        {
            temp = temp->next;
        }
        newNode->next = temp->next;
        temp->next->prev = newNode;
        temp->next = newNode;
        newNode->prev = temp;
    }
    void deleteFirst()
    {
        Node *temp = head;
        head = head->next;
        head->prev = NULL;
        delete temp;
    }
    void deleteLast()
    {
        Node *temp = tail;
        tail = tail->prev;
        tail->next = NULL;
        delete temp;
    }
    void deleteSpecific(int key)
    {
        Node *temp = head;
        while (temp->data != key)
        {
            temp = temp->next;
        }
        temp->prev->next = temp->next;
        temp->next->prev = temp->prev;
        delete temp;
    }

    void traverseReverse()
    {
        Node *temp = tail;
        while (temp != NULL)
        {
            cout << temp->data << " ";
            temp = temp->prev;
        }
        cout << endl;
    }

    void display()
    {
        Node *temp = head;
        while (temp != NULL)
        {
            cout << temp->data << " ";
            temp = temp->next;
        }
        cout << endl;
    }

    void completeDelete()
    {
        Node *temp = head;
        while (temp != NULL)
        {
            Node *toDelete = temp;
            temp = temp->next;
            delete toDelete;
        }
        head = NULL;
        tail = NULL;
    }

    // Graded Lab 2

    void swapTwoNodes(int key1, int key2){
        Node *temp1 = head;
        Node *temp2 = head;
        while(temp1->data != key1){
            temp1 = temp1->next;
        }
        while(temp2->data != key2){
            temp2 = temp2->next;
        }
        int temp = temp1->data;
```

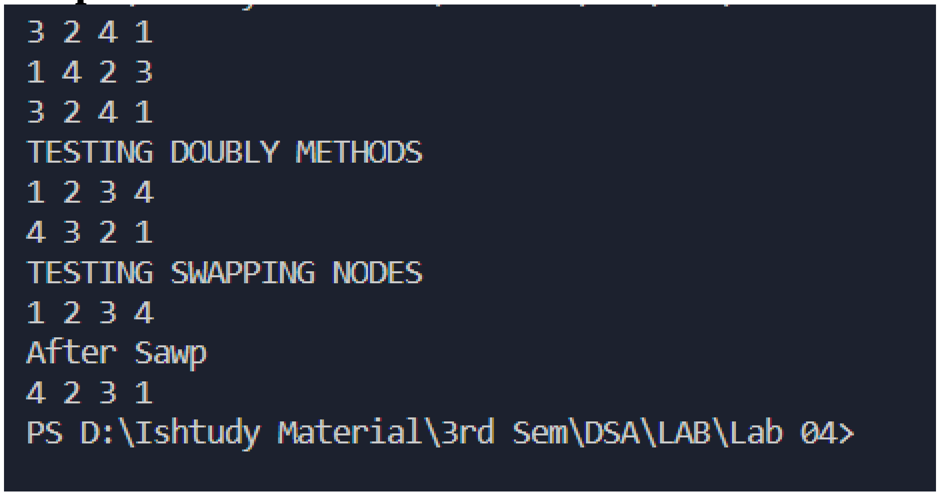


```cpp
        temp1->data = temp2->data;
        temp2->data = temp;
    }

    // Graded Lab task

    void reverseAllNodes()
    {
        Node *temp = head;
        while (temp != NULL)
        {
            Node *temp2 = temp->next;
            temp->next = temp->prev;
            temp->prev = temp2;
            temp = temp2;
        }
        temp = head;
        head = tail;
        tail = temp;
    }
};

DoublyLinkedList makeDoubly(SinglyLinkedList list)
{
    DoublyLinkedList newList;
    Node *temp = list.head;
    while (temp != NULL)
    {
        newList.insertAtEnd(temp->data);
        temp = temp->next;
    }
    return newList;
}

int main()
{
    DoublyLinkedList *list = new DoublyLinkedList();
    list->insertAtEnd(1);
    list->insertAtHead(2);
    list->insertAtHead(3);
    list->insertAtSpecific(4, 2);
    list->display();
    list->reverseAllNodes();
    list->display();
    list->traverseReverse();
```



```cpp
    cout<<"TESTING DOUBLY METHODS";


    cout<<endl;

    // Making Singly Linked List to check if it can be converted in doubly
    SinglyLinkedList *l1 = new SinglyLinkedList();
    l1->insert(1);
    l1->insert(2);
    l1->insert(3);
    l1->insert(4);
    l1->display();
    DoublyLinkedList l2;
    l2 = makeDoubly(*l1);
    l2.traverseReverse();

    // Testing swapping Nodes
    cout<<"TESTING SWAPPING NODES"<<endl;
    l2.display();

    l2.swapTwoNodes(1,4);


    cout<<"After Sawp" <<endl;

    l2.display();

    return 0;
}
```

Output:



```
3 2 4 1
1 4 2 3
3 2 4 1
TESTING DOUBLY METHODS
1 2 3 4
4 3 2 1
TESTING SWAPPING NODES
1 2 3 4
After Sawp
4 2 3 1
PS D:\Ishtudy Material\3rd Sem\DSA\LAB\Lab 04>
```