2023

LAB # 03 - ASSIGNMENT

DATA STRUCTURES ALGORITHMS AND APPLICATIONS (CT – 159)

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GROUP 16

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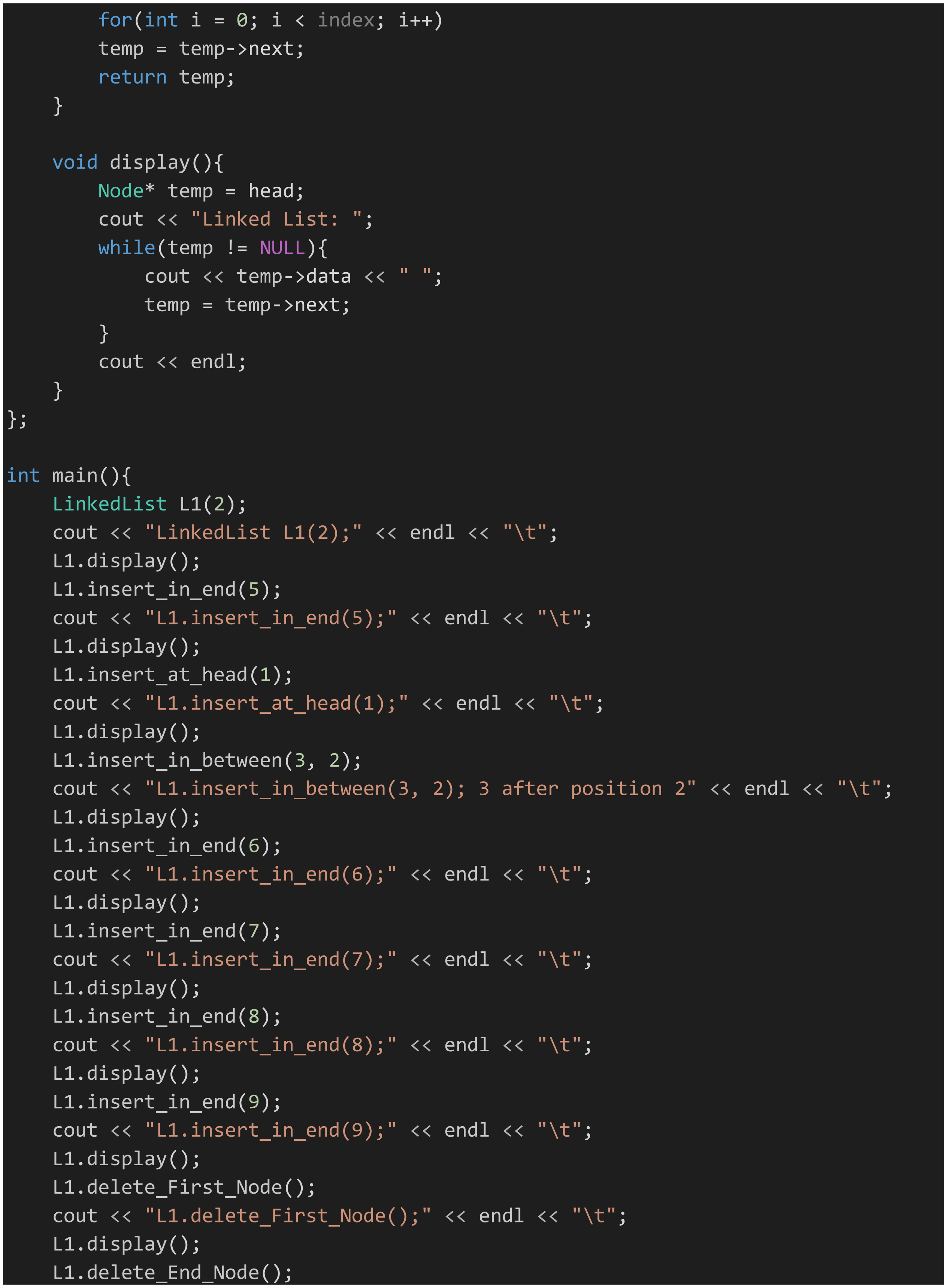
EXERCISE

```
/*
DSAA LAB 3
11 NOV 2023

1. Implement a singly linked list class with the following functions:
a) Insert a node at head
b) Insert  a node at tail/end/back
c) Insert a node at any position
d) Delete a node by value
e) Delete head
f) Delete tail
g) Delete a node at any position.

*/

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

struct Node{
    int data;
    struct Node* next;
};

class LinkedList{
    struct Node* head;

    public:
    LinkedList(int newdata){
        struct Node* newNode = (struct Node*) malloc(sizeof(struct Node*));
        newNode->data = newdata;
        newNode->next = NULL;
        head = newNode;
    }

    void insert_at_head(int newdata){
        Node* newNode = (struct Node*) malloc(sizeof(struct Node));
        newNode->data = newdata;
        newNode->next = head;
        head = newNode;
    }
```

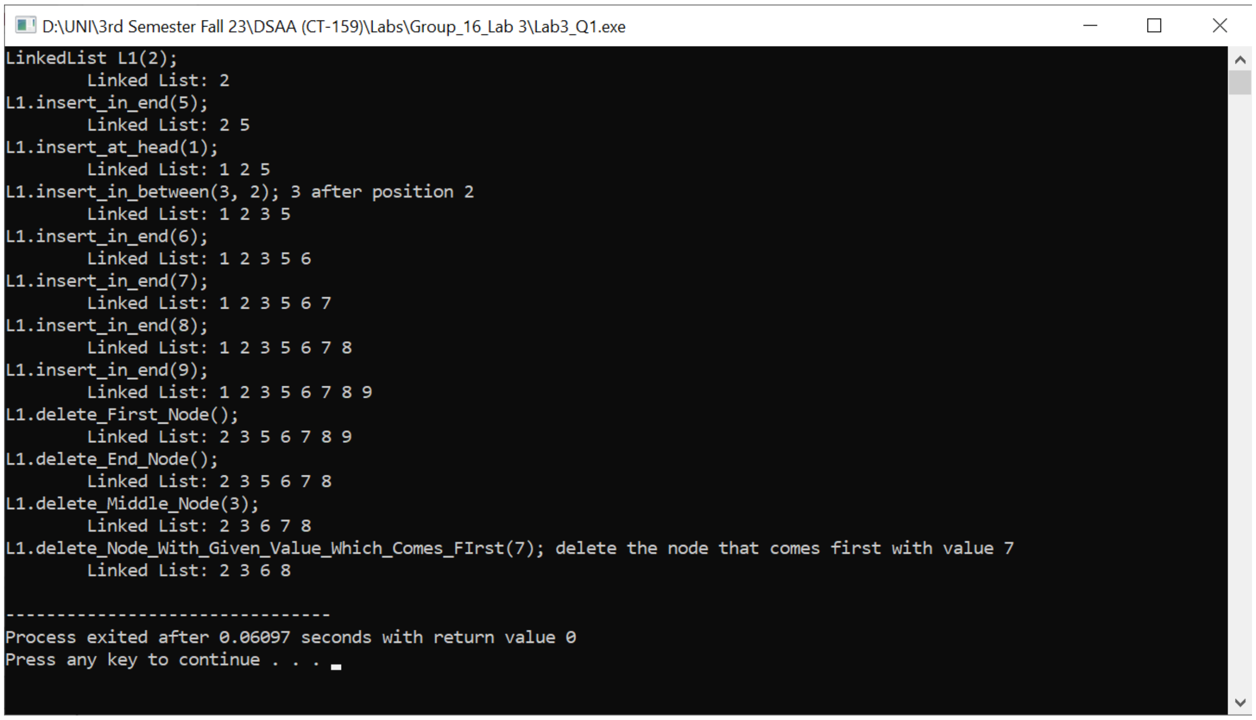
```c
void insert_in_between(int newdata, int position){
    Node* newNode = (struct Node*) malloc (sizeof(struct Node));
    newNode->data = newdata;

    Node *temp = head;
    int i = 0;

    while(i != position-1){
        temp = temp->next;
        i++;
    }

    newNode->next = temp->next;
    temp->next = newNode;
}

void insert_in_end(int newdata){
    Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = newdata;
    newNode->next = NULL;
    Node* temp = head;

    while(temp->next != NULL){
        temp = temp->next;
    }

    temp->next = newNode;
}

void insert_after_node(Node* prevNode, int newdata){
    Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = newdata;
    newNode->next = prevNode->next;
    prevNode->next = newNode;
}

void delete_First_Node(){
    Node *temp = head;
    head = head->next;
    free(temp);
}

void delete_End_Node(){
    Node *temp = head;
```

```
        while(temp->next->next != NULL){
            temp = temp->next;
        }
        Node *temp2 = temp->next;
        temp->next = NULL;
        free(temp2);
    }

    void delete_Middle_Node(int position){ // position is index, will not run on
index = 0, as it will be the starting one
        Node *temp = head;
        int i = 1;
        while(i != position-1){
            temp = temp->next;
            i++;
        }
        Node *temp2 = temp->next;
        temp->next = temp2->next;
        free(temp2);
    }

    void delete_Node_With_Given_Value_Which_Comes_FIrst(int value){
        Node *temp = head, *temp2 = head->next;
        while(temp2->data != value){        // loop for traversing
            if(temp->data == value){        // if given data is in 0 index i.e.
head
                delete_First_Node();        // first index, call function delete
first node
                free(temp);                 // free mempry
                return;                     // end function
            }
            temp = temp->next;
            temp2 = temp2->next;
        }
        if(temp2->next == NULL){            // if given data is in last index
            temp->next = NULL;              // same as delete_end_node function
            free(temp2);                    // free memory
            return;                         // end function
        }
        temp->next = temp2->next;
        free(temp2);
    }

    struct Node* getNode(int index){
        Node *temp = head;
```



```cpp
        for(int i = 0; i < index; i++)
        temp = temp->next;
        return temp;
    }

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

int main(){
    LinkedList L1(2);
    cout << "LinkedList L1(2);" << endl << "\t";
    L1.display();
    L1.insert_in_end(5);
    cout << "L1.insert_in_end(5);" << endl << "\t";
    L1.display();
    L1.insert_at_head(1);
    cout << "L1.insert_at_head(1);" << endl << "\t";
    L1.display();
    L1.insert_in_between(3, 2);
    cout << "L1.insert_in_between(3, 2); 3 after position 2" << endl << "\t";
    L1.display();
    L1.insert_in_end(6);
    cout << "L1.insert_in_end(6);" << endl << "\t";
    L1.display();
    L1.insert_in_end(7);
    cout << "L1.insert_in_end(7);" << endl << "\t";
    L1.display();
    L1.insert_in_end(8);
    cout << "L1.insert_in_end(8);" << endl << "\t";
    L1.display();
    L1.insert_in_end(9);
    cout << "L1.insert_in_end(9);" << endl << "\t";
    L1.display();
    L1.delete_First_Node();
    cout << "L1.delete_First_Node();" << endl << "\t";
    L1.display();
    L1.delete_End_Node();
    cout << "L1.delete_End_Node();" << endl << "\t";
    L1.display();
    L1.delete_Middle_Node(3);
    cout << "L1.delete_Middle_Node(3);" << endl << "\t";
    L1.display();
    L1.delete_Node_With_Given_Value_Which_Comes_FIrst(7);
    cout << "L1.delete_Node_With_Given_Value_Which_Comes_FIrst(7); delete the 
node that comes first with value 7" << endl << "\t";
    L1.display();

    return 0;

}
```

OUTPUT:


D:\UNI\3rd Semester Fall 23\DSAA (CT-159)\Labs\Group_16_Lab 3\Lab3_Q1.exe

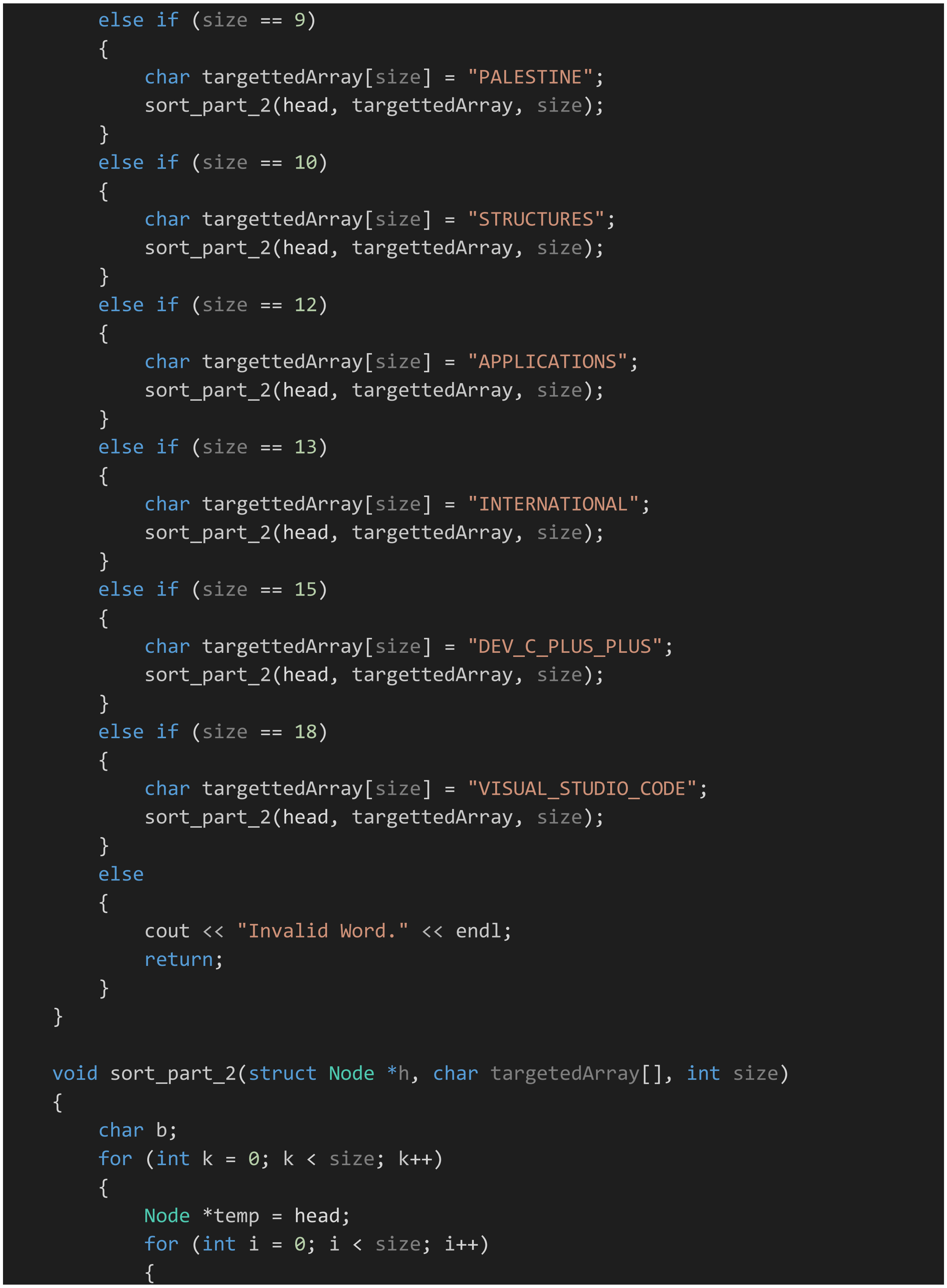
```
LinkedList L1(2);
        Linked List: 2
L1.insert_in_end(5);
        Linked List: 2 5
L1.insert_at_head(1);
        Linked List: 1 2 5
L1.insert_in_between(3, 2); 3 after position 2
        Linked List: 1 2 3 5
L1.insert_in_end(6);
        Linked List: 1 2 3 5 6
L1.insert_in_end(7);
        Linked List: 1 2 3 5 6 7
L1.insert_in_end(8);
        Linked List: 1 2 3 5 6 7 8
L1.insert_in_end(9);
        Linked List: 1 2 3 5 6 7 8 9
L1.delete_First_Node();
        Linked List: 2 3 5 6 7 8 9
L1.delete_End_Node();
        Linked List: 2 3 5 6 7 8
L1.delete_Middle_Node(3);
        Linked List: 2 3 6 7 8
L1.delete_Node_With_Given_Value_Which_Comes_FIrst(7); delete the node that comes first with value 7
        Linked List: 2 3 6 8

--------------------------------
Process exited after 0.06097 seconds with return value 0
Press any key to continue . . .
```

```
/*
DSAA LAB 3
11 NOV 2023

2. Solve the following problem using a Singly Linked List. Given a singly linked
list of
characters, write a function to make word out of given letters in the list. Test
Case:
Input:C->S->A->R->B->B->E->L->NULL,
Output:S->C->R->A->B->B->L->E->NULL

*/

#include <iostream>
#include <string.h>
#include<cstdlib>
using namespace std;

void swap(char *a, char *b)
{ // swapping of variables, also can be done with that method temp = a; a = b; b
= temp;
    *a = *a + *b;
    *b = *a - *b;
    *a = *a - *b;
}

struct Node
{
    char data;
    struct Node *next;
};

class LinkedList
{
    struct Node *head;

public:
    LinkedList(char newdata)
    {
        Node *newNode = (struct Node *)malloc(sizeof(struct Node));
        newNode->data = newdata;
        newNode->next = NULL;
        head = newNode;
    }
```

```c
void insert_at_head(char newdata)
{
    Node *newNode = (struct Node *)malloc(sizeof(struct Node));
    newNode->data = newdata;
    newNode->next = head;
    head = newNode;
}

void insert_in_between(char newdata, int position)
{
    Node *newNode = (struct Node *)malloc(sizeof(struct Node));
    newNode->data = newdata;

    Node *temp = head;
    int i = 0;

    while (i != position - 1)
    {
        temp = temp->next;
        i++;
    }

    newNode->next = temp->next;
    temp->next = newNode;
}

void insert_in_end(char newdata)
{
    Node *newNode = (struct Node *)malloc(sizeof(struct Node));
    newNode->data = newdata;
    newNode->next = NULL;
    Node *temp = head;

    while (temp->next != NULL)
    {
        temp = temp->next;
    }

    temp->next = newNode;
}

void insert_after_node(Node *prevNode, char newdata)
{
    Node *newNode = (struct Node *)malloc(sizeof(struct Node));
    newNode->data = newdata;
```

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

    void delete_First_Node()
    {
        Node *temp = head;
        head = head->next;
        free(temp);
    }

    void delete_End_Node()
    {
        Node *temp = head;
        while (temp->next->next != NULL)
        {
            temp = temp->next;
        }
        Node *temp2 = temp->next;
        temp->next = NULL;
        free(temp2);
    }

    void delete_Middle_Node(int position)
    { // position is index, will not run on index = 0, as it will be the starting
one
        Node *temp = head;
        int i = 1;
        while (i != position - 1)
        {
            temp = temp->next;
            i++;
        }
        Node *temp2 = temp->next;
        temp->next = temp2->next;
        free(temp2);
    }

    void delete_Node_With_Given_Value_Which_Comes_FIrst(char value)
    {
        Node *temp = head, *temp2 = head->next;
        while (temp2->data != value)
        { // loop for traversing
            if (temp->data == value)
            {                        // if given data is in 0 index i.e. head
```

```
                delete_First_Node(); // first index, call function delete first node
                free(temp);          // free mempry
                return;              // end function
            }
            temp = temp->next;
            temp2 = temp2->next;
        }
        if (temp2->next == NULL)
        {                      // if given data is in last index
            temp->next = NULL; // same as delete_end_node function
            free(temp2);       // free memory
            return;            // end function
        }
        temp->next = temp2->next;
        free(temp2);
    }

    void sort_word(int size)
    {
        if (size == 4)
        {
            char targettedArray[size] = "GAZA";
            sort_part_2(head, targettedArray, size);
        }
        else if (size == 5)
        {
            char targettedArray[size] = "SYRIA";
            sort_part_2(head, targettedArray, size);
        }
        else if (size == 6)
        {
            char targettedArray[size] = "PYTHON";
            sort_part_2(head, targettedArray, size);
        }
        else if (size == 7)
        {
            char targettedArray[size] = "LEBANON";
            sort_part_2(head, targettedArray, size);
        }
        else if (size == 8)
        {
            char targettedArray[size] = "SCRABBLE";
            sort_part_2(head, targettedArray, size);
        }
```

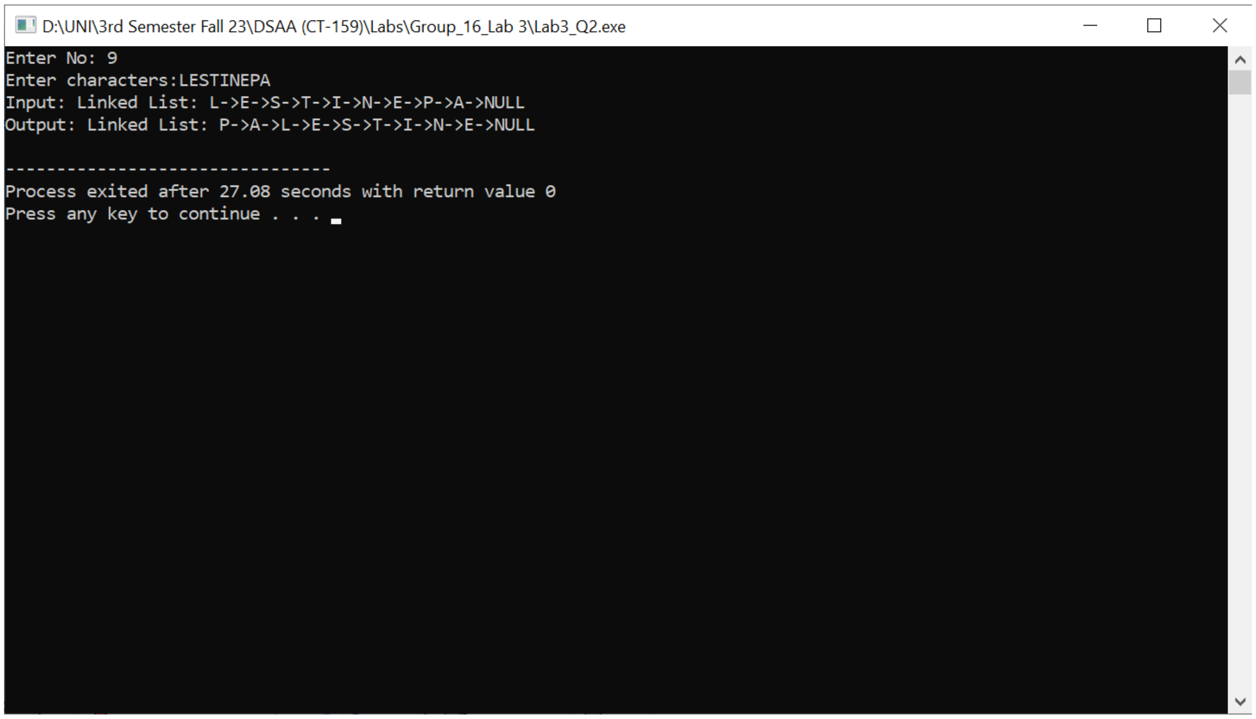


```
    else if (size == 9)
    {
        char targettedArray[size] = "PALESTINE";
        sort_part_2(head, targettedArray, size);
    }
    else if (size == 10)
    {
        char targettedArray[size] = "STRUCTURES";
        sort_part_2(head, targettedArray, size);
    }
    else if (size == 12)
    {
        char targettedArray[size] = "APPLICATIONS";
        sort_part_2(head, targettedArray, size);
    }
    else if (size == 13)
    {
        char targettedArray[size] = "INTERNATIONAL";
        sort_part_2(head, targettedArray, size);
    }
    else if (size == 15)
    {
        char targettedArray[size] = "DEV_C_PLUS_PLUS";
        sort_part_2(head, targettedArray, size);
    }
    else if (size == 18)
    {
        char targettedArray[size] = "VISUAL_STUDIO_CODE";
        sort_part_2(head, targettedArray, size);
    }
    else
    {
        cout << "Invalid Word." << endl;
        return;
    }
}

void sort_part_2(struct Node *h, char targetedArray[], int size)
{
    char b;
    for (int k = 0; k < size; k++)
    {
        Node *temp = head;
        for (int i = 0; i < size; i++)
        {
```

```cpp
                b = targetedArray[i];
                Node *temp2 = head;
                for (int j = 0; j < size; j++)
                {
                    if (temp2->data == b)
                    {
                        swap(temp2->data, temp->data);
                        break;
                    }
                    temp2 = temp2->next;
                }
                temp = temp->next;
            }
        }
    }

    struct Node *getNode(int index)
    {
        Node *temp = head;
        for (int i = 0; i < index; i++)
            temp = temp->next;
        return temp;
    }

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

    void swapNodes(struct Node *a, struct Node *b)
    {
        a->data = a->data + b->data;
        b->data = a->data - b->data;
        a->data = a->data - b->data;
    }
};
```

```cpp
int main()
{
    cout << "Enter No: ";
    int no;
    cin >> no;

    char a[no];
    cout << "Enter characters:";

    for (int i = 0; i < no; i++)
        cin >> a[i];

    LinkedList L1(a[0]);

    for (int i = 1; i < no; i++)
        L1.insert_in_end(a[i]);

    cout << "Input: ";
    L1.display();

    L1.sort_word(no);

    cout << "Output: ";
    L1.display();
}
```

OUTPUT:



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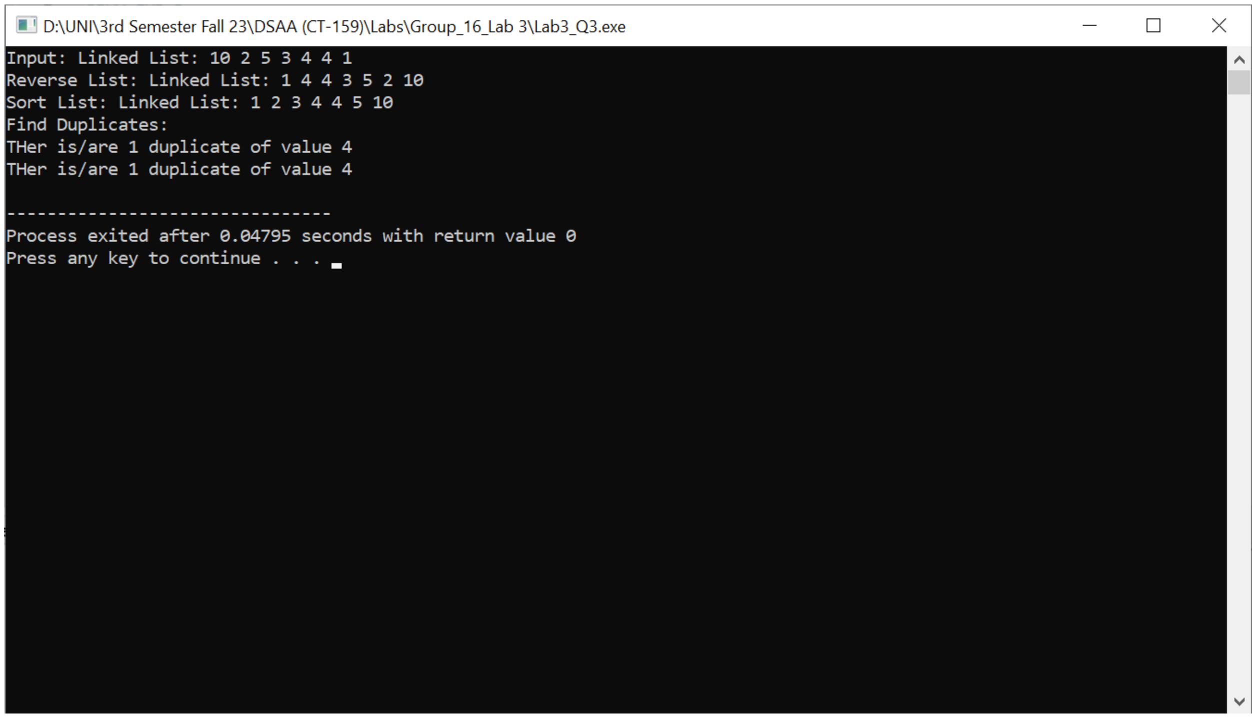
```
Enter No: 9
Enter characters:LESTINEPA
Input: Linked List: L->E->S->T->I->N->E->P->A->NULL
Output: Linked List: P->A->L->E->S->T->I->N->E->NULL

--------------------------------
Process exited after 27.08 seconds with return value 0
Press any key to continue . . .
```

```
/*
DSAA LAB 3
11 NOV 2023

3. Use the class of SLL created by you during the lab task 1. Do the following:
a) Reverse the linked list
b) Sort the contents of linked list
c) Find the duplicates in the linked list

*/

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

void swap(int *a, int *b)
{
    *a = *a + *b;
    *b = *a - *b;
    *a = *a - *b;
}

struct Node
{
    int data;
    struct Node *next;
};

class LinkedList
{
    struct Node *head;

public:
    LinkedList(int newdata)
    {
        Node *newNode = (struct Node *)malloc(sizeof(struct Node));
        newNode->data = newdata;
        newNode->next = NULL;
        head = newNode;
    }

    void insert_at_head(int newdata)
    {
        Node *newNode = (struct Node *)malloc(sizeof(struct Node));
        newNode->data = newdata;
```

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

    void insert_in_between(int newdata, int position)
    {
        Node *newNode = (struct Node *)malloc(sizeof(struct Node));
        newNode->data = newdata;

        Node *temp = head;
        int i = 0;

        while (i != position - 1)
        {
            temp = temp->next;
            i++;
        }

        newNode->next = temp->next;
        temp->next = newNode;
    }

    void insert_in_end(int newdata)
    {
        Node *newNode = (struct Node *)malloc(sizeof(struct Node));
        newNode->data = newdata;
        newNode->next = NULL;
        Node *temp = head;

        while (temp->next != NULL)
        {
            temp = temp->next;
        }

        temp->next = newNode;
    }

    void insert_after_node(Node *prevNode, int newdata)
    {
        Node *newNode = (struct Node *)malloc(sizeof(struct Node));
        newNode->data = newdata;
        newNode->next = prevNode->next;
        prevNode->next = newNode;
    }
    void delete_First_Node()
    {
        Node *temp = head;
        head = head->next;
        free(temp);
    }

    void delete_End_Node()
    {
        Node *temp = head;
        while (temp->next->next != NULL)
        {
            temp = temp->next;
        }
        Node *temp2 = temp->next;
        temp->next = NULL;
        free(temp2);
    }

    void delete_Middle_Node(int position)
    { // position is index, will not run on index = 0, as it will be the starting
one
        Node *temp = head;
        int i = 1;
        while (i != position - 1)
        {
            temp = temp->next;
            i++;
        }
        Node *temp2 = temp->next;
        temp->next = temp2->next;
        free(temp2);
    }

    void delete_Node_With_Given_Value_Which_Comes_FIrst(int value)
    {
        Node *temp = head, *temp2 = head->next;
        while (temp2->data != value)
        { // loop for traversing
            if (temp->data == value)
            {                        // if given data is in 0 index i.e. head
                delete_First_Node(); // first index, call function delete first
node
                free(temp);          // free mempry
                return;              // end function
            }
            temp = temp->next;
            temp2 = temp2->next;
        }
        if (temp2->next == NULL)
        {                      // if given data is in last index
            temp->next = NULL; // same as delete_end_node function
            free(temp2);       // free memory
            return;            // end function
        }
        temp->next = temp2->next;
        free(temp2);
    }

    struct Node *getNode(int index)
    {
        Node *temp = head;
        for (int i = 0; i < index; i++)
            temp = temp->next;
        return temp;
    }

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

    void reverseList()
    {
        Node *next = NULL, *prev = NULL;
        while (head != NULL)
        {
            next = head->next;
            head->next = prev;
            prev = head;
            head = next;
        }
        head = prev;
    }

    void sortList()
    {
        Node *current = head, *next = head->next, *count = head;
        while (count != NULL)
        {
            next = head->next;
            current = head;
            while (next != NULL)
            {
                if (current->data > next->data)
                {
                    swap(current->data, next->data);
                }
                current = current->next;
                next = next->next;
            }
            count = count->next;
        }
    }

    void findDuplicates()
    {
        Node* temp = head, *temp2 = head, *temp3 = head;
        int count = 0, i;
        while(temp != NULL){
            temp = temp->next;
            count++;
        }
        int duplicates[count];
        for(i = 0; i < count; i++)
        duplicates[i] = 0;

        i = 0;

        temp = head;
        while(temp != NULL){
            temp2 = head;
            while(temp2 != NULL){
                if((temp2->data == temp->data) && (temp != temp2)){
                    duplicates[i]++;
                }
                temp2 = temp2->next;
            }
            temp = temp->next;
            i++;
        }

        temp = head;
        for(int j = 0; j < count; j++){
            if(duplicates[j] != 0){
                cout << "THer is/are " << duplicates[j] << " duplicate of value "
<< temp->data << endl;
            }
            temp = temp->next;
        }
    }
};

int main()
{
    LinkedList L1(10);
    L1.insert_in_end(2);
    L1.insert_in_end(5);
    L1.insert_in_end(3);
    L1.insert_in_end(4);
    L1.insert_in_end(4);
    L1.insert_in_end(1);
    cout << "Input: ";
    L1.display();
    L1.reverseList();
    cout << "Reverse List: ";
    L1.display();
    L1.sortList();
    cout << "Sort List: ";
    L1.display();
    cout << "Find Duplicates:" << endl;
    L1.findDuplicates();

    return 0;
}
```

OUTPUT:



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```
Input: Linked List: 10 2 5 3 4 4 1
Reverse List: Linked List: 1 4 4 3 5 2 10
Sort List: Linked List: 1 2 3 4 4 5 10
Find Duplicates:
THer is/are 1 duplicate of value 4
THer is/are 1 duplicate of value 4

--------------------------------
Process exited after 0.04795 seconds with return value 0
Press any key to continue . . .
```