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19BEC1112

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CSE2003

Data Structures and Algorithms

[LAB]

LAB – 4

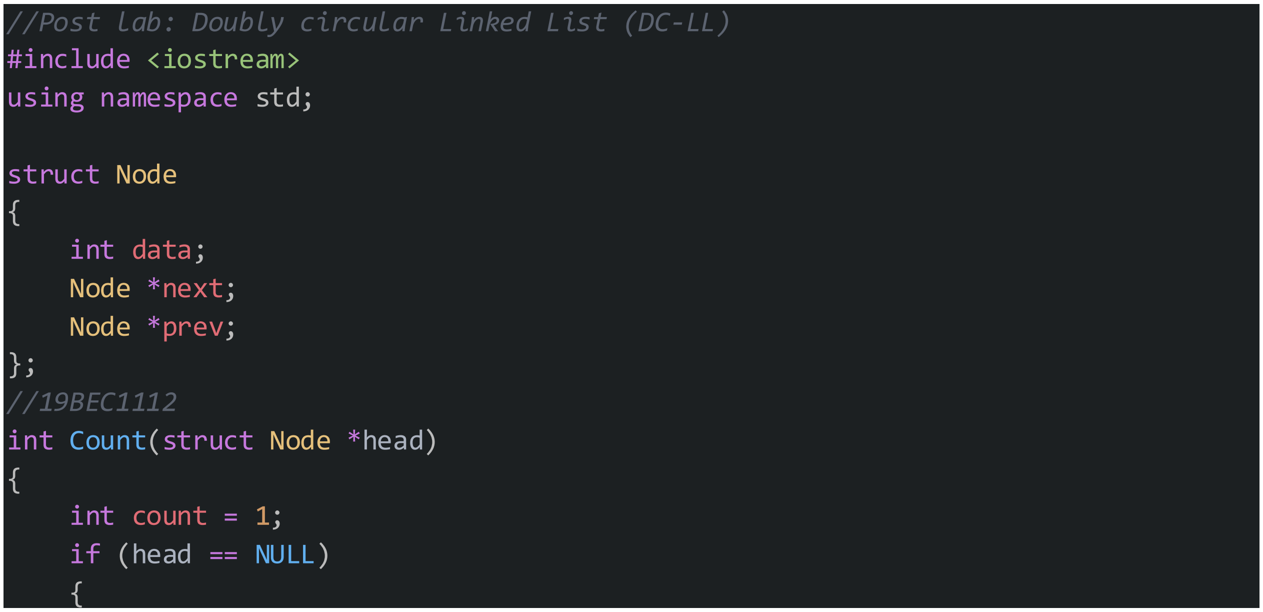
Doubly Linked Lists and Polynomials

Aim: To implement doubly linked lists (linear and circular) and implement polynomial operations using linked lists.

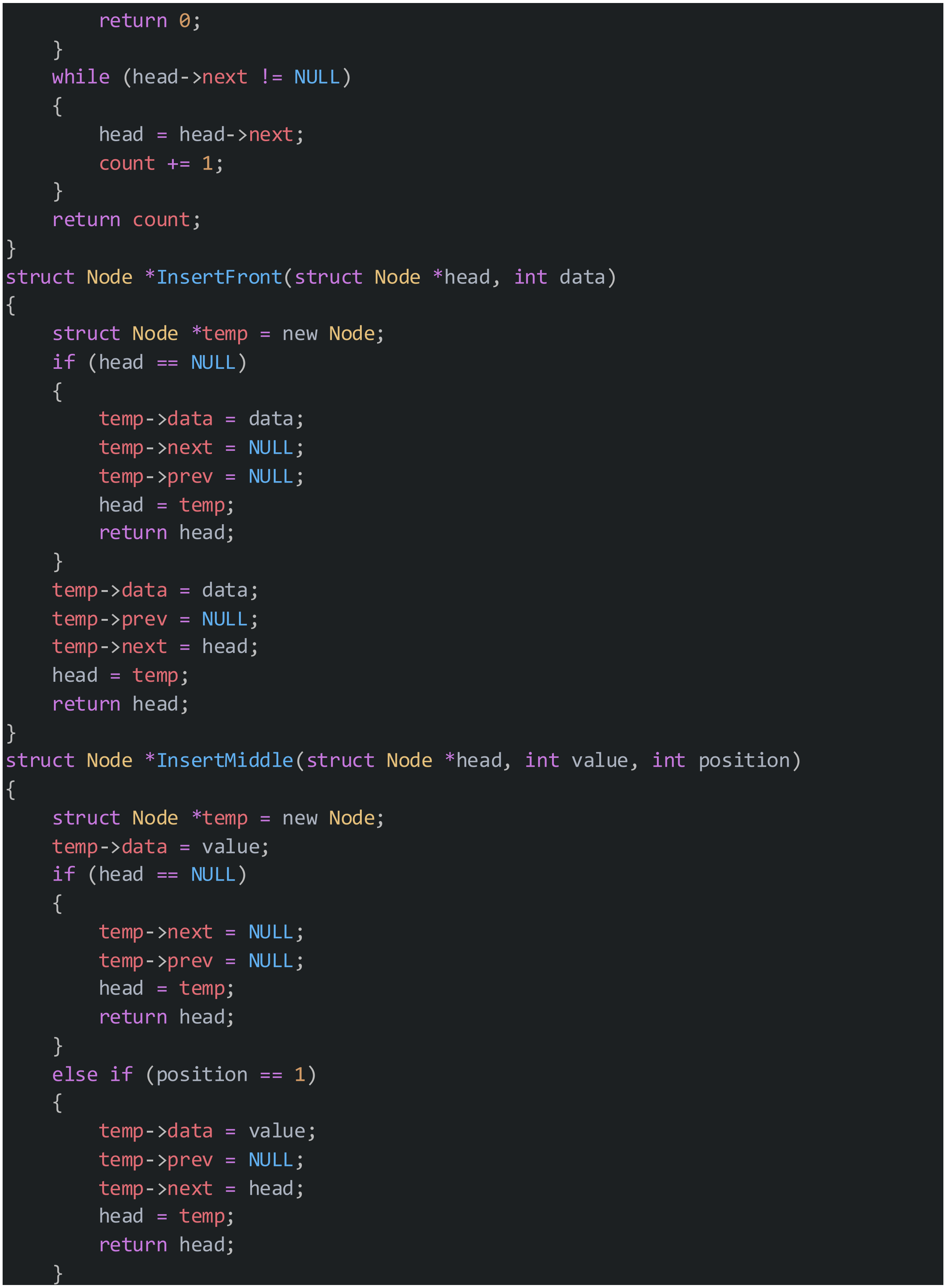
Software Required: Code editor (e.g. VS Code, Dev C++), GCC/G++ compiler

Task 1: To create a linear doubly linked list and perform create, insert, display, count, and delete operations.

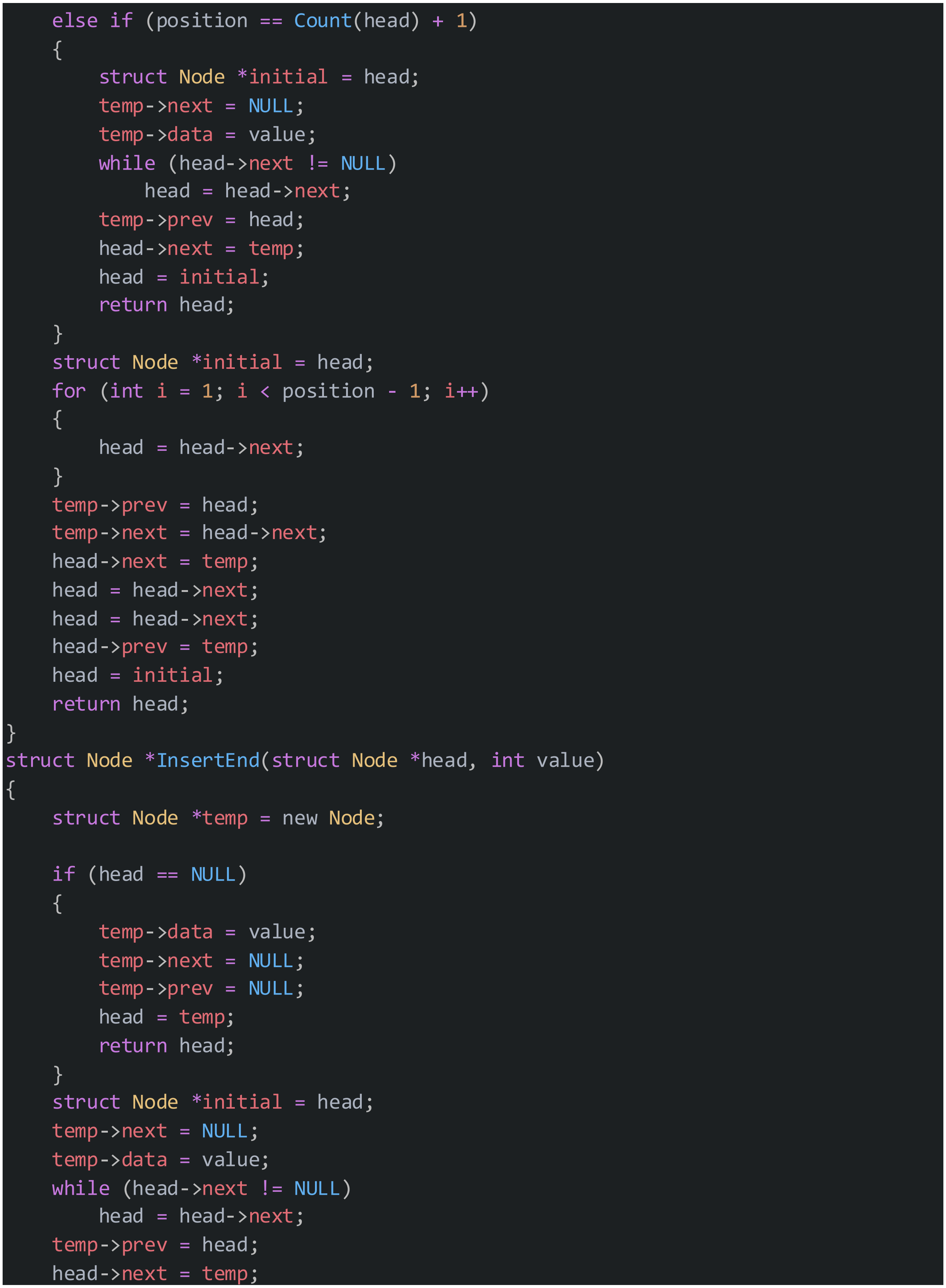
Code:



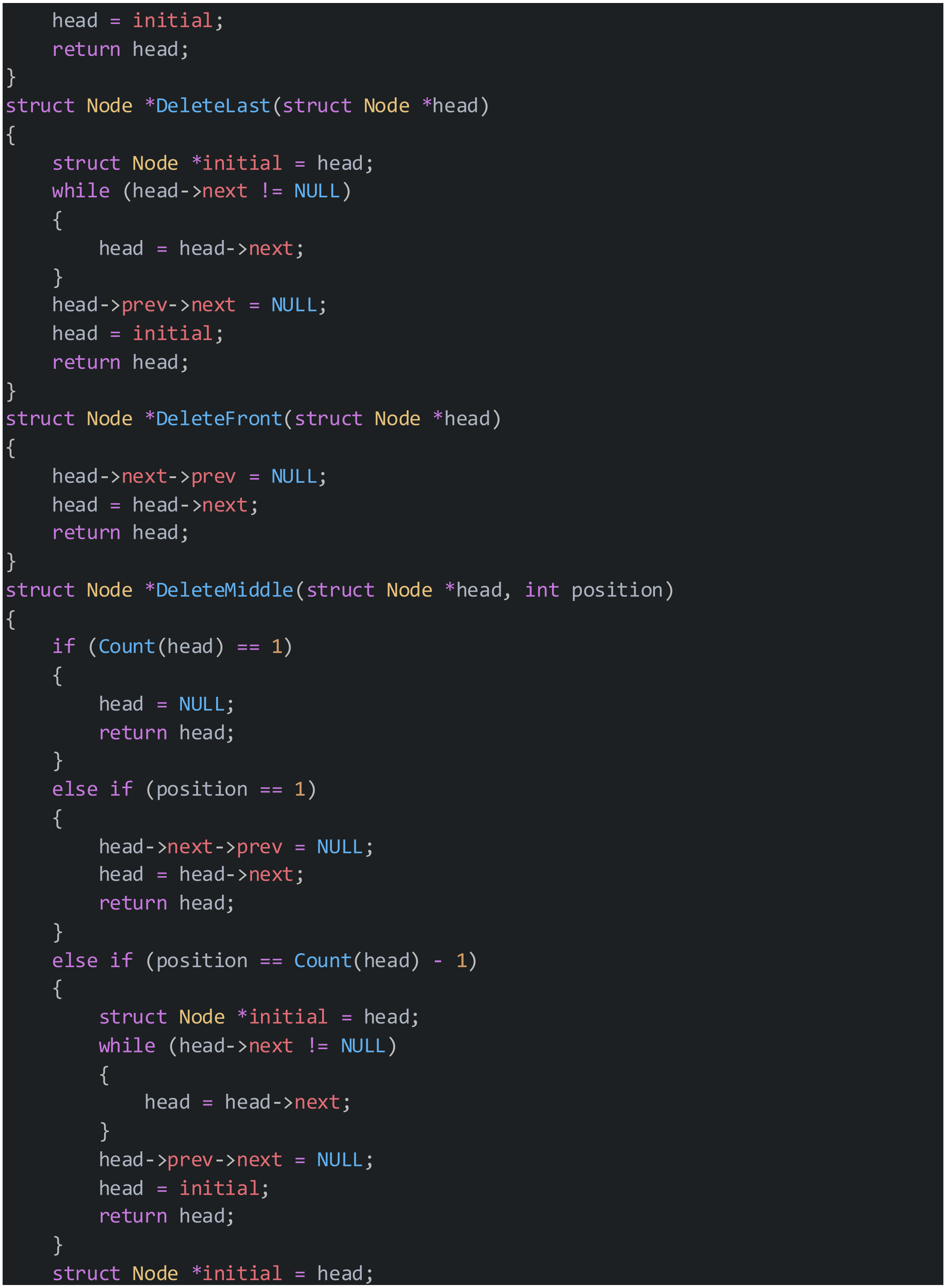
```
//Post lab: Doubly circular Linked List (DC-LL)
#include <iostream>
using namespace std;

struct Node
{
    int data;
    Node *next;
    Node *prev;
};
//19BEC1112
int Count(struct Node *head)
{
    int count = 1;
    if (head == NULL)
    {
```



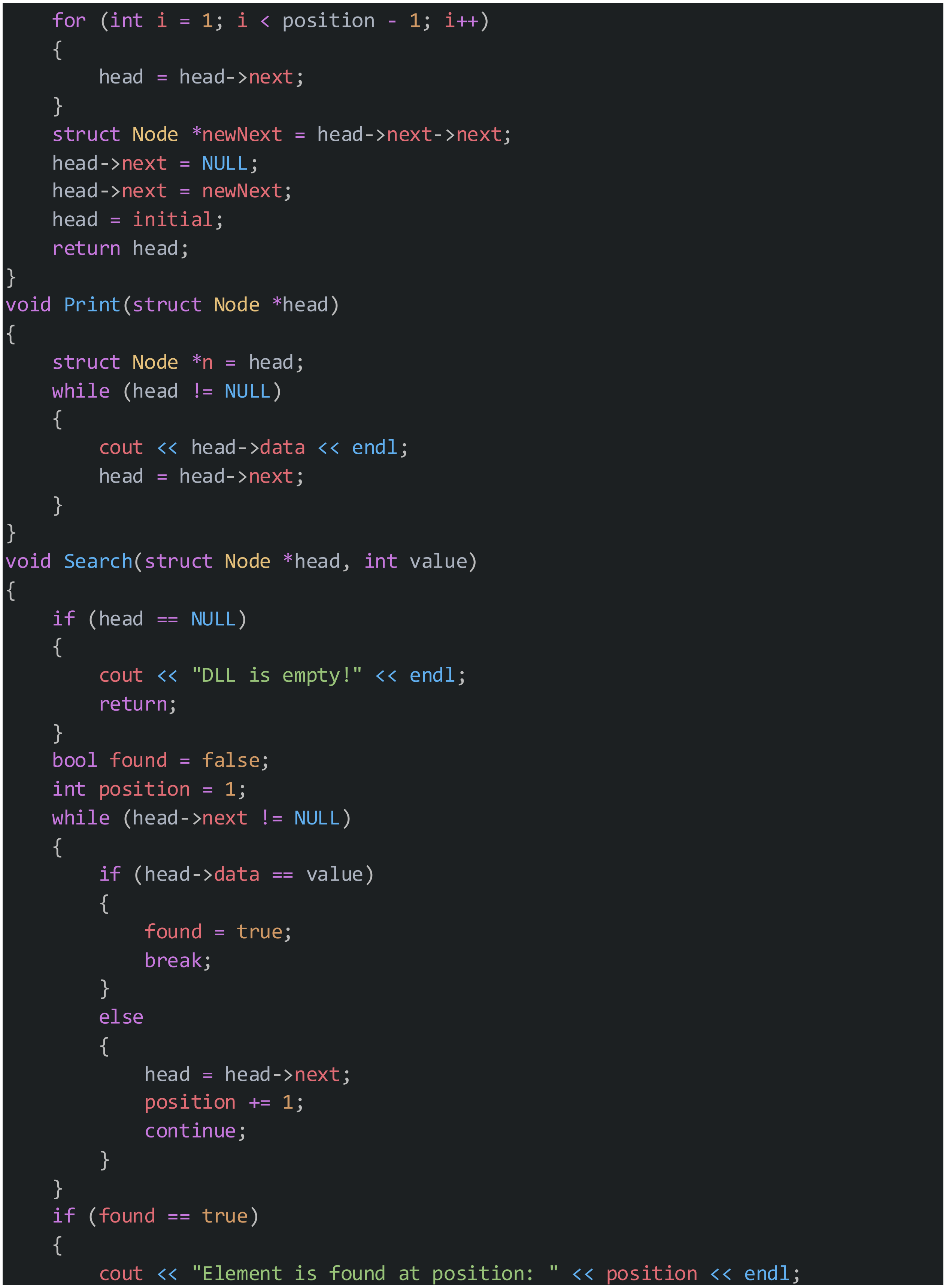
```
        return 0;
    }
    while (head->next != NULL)
    {
        head = head->next;
        count += 1;
    }
    return count;
}
struct Node *InsertFront(struct Node *head, int data)
{
    struct Node *temp = new Node;
    if (head == NULL)
    {
        temp->data = data;
        temp->next = NULL;
        temp->prev = NULL;
        head = temp;
        return head;
    }
    temp->data = data;
    temp->prev = NULL;
    temp->next = head;
    head = temp;
    return head;
}
struct Node *InsertMiddle(struct Node *head, int value, int position)
{
    struct Node *temp = new Node;
    temp->data = value;
    if (head == NULL)
    {
        temp->next = NULL;
        temp->prev = NULL;
        head = temp;
        return head;
    }
    else if (position == 1)
    {
        temp->data = value;
        temp->prev = NULL;
        temp->next = head;
        head = temp;
        return head;
    }
```



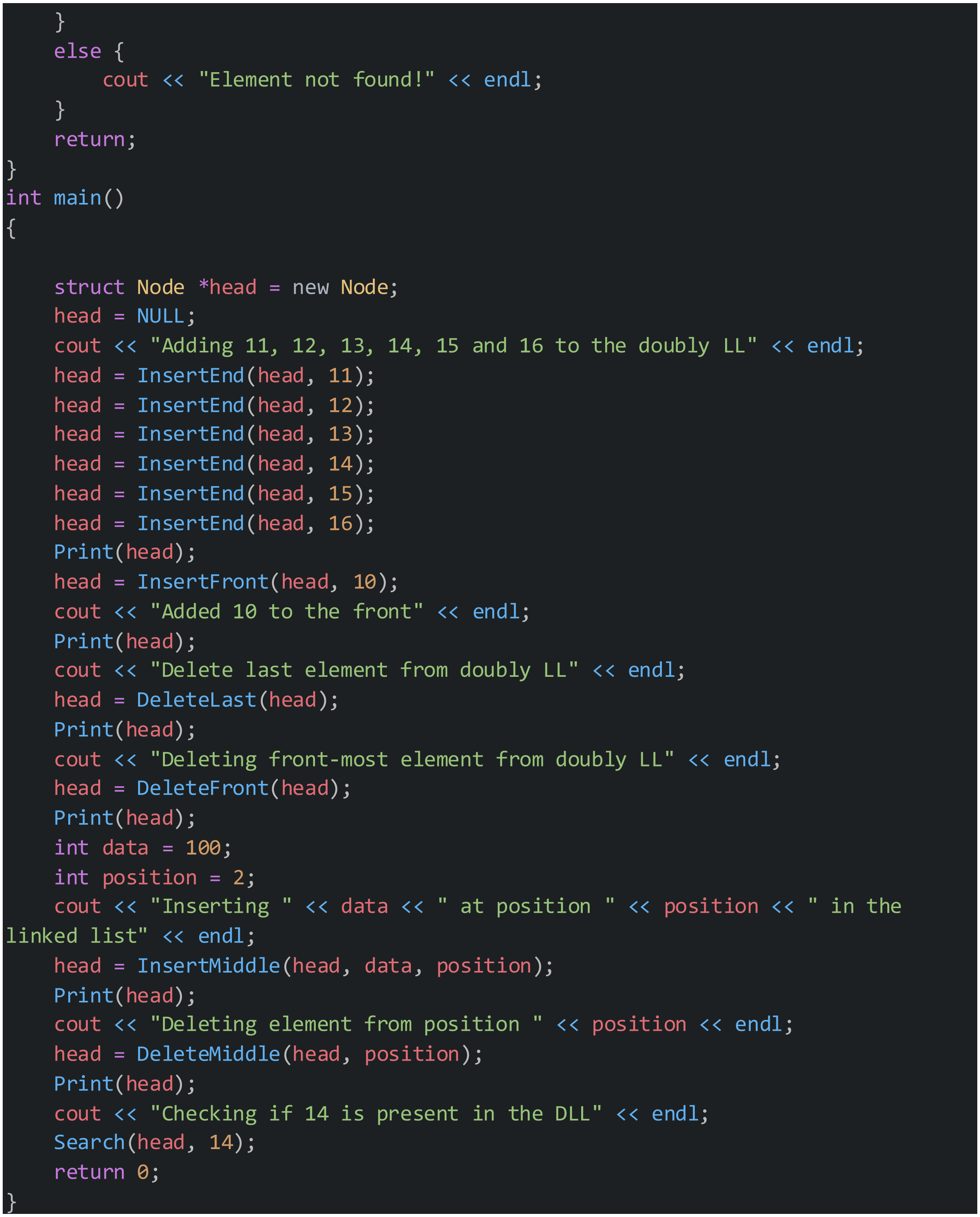
```
    else if (position == Count(head) + 1)
    {
        struct Node *initial = head;
        temp->next = NULL;
        temp->data = value;
        while (head->next != NULL)
            head = head->next;
        temp->prev = head;
        head->next = temp;
        head = initial;
        return head;
    }
    struct Node *initial = head;
    for (int i = 1; i < position - 1; i++)
    {
        head = head->next;
    }
    temp->prev = head;
    temp->next = head->next;
    head->next = temp;
    head = head->next;
    head = head->next;
    head->prev = temp;
    head = initial;
    return head;
}
struct Node *InsertEnd(struct Node *head, int value)
{
    struct Node *temp = new Node;

    if (head == NULL)
    {
        temp->data = value;
        temp->next = NULL;
        temp->prev = NULL;
        head = temp;
        return head;
    }
    struct Node *initial = head;
    temp->next = NULL;
    temp->data = value;
    while (head->next != NULL)
        head = head->next;
    temp->prev = head;
    head->next = temp;
```



```
    head = initial;
    return head;
}
struct Node *DeleteLast(struct Node *head)
{
    struct Node *initial = head;
    while (head->next != NULL)
    {
        head = head->next;
    }
    head->prev->next = NULL;
    head = initial;
    return head;
}
struct Node *DeleteFront(struct Node *head)
{
    head->next->prev = NULL;
    head = head->next;
    return head;
}
struct Node *DeleteMiddle(struct Node *head, int position)
{
    if (Count(head) == 1)
    {
        head = NULL;
        return head;
    }
    else if (position == 1)
    {
        head->next->prev = NULL;
        head = head->next;
        return head;
    }
    else if (position == Count(head) - 1)
    {
        struct Node *initial = head;
        while (head->next != NULL)
        {
            head = head->next;
        }
        head->prev->next = NULL;
        head = initial;
        return head;
    }
    struct Node *initial = head;
```

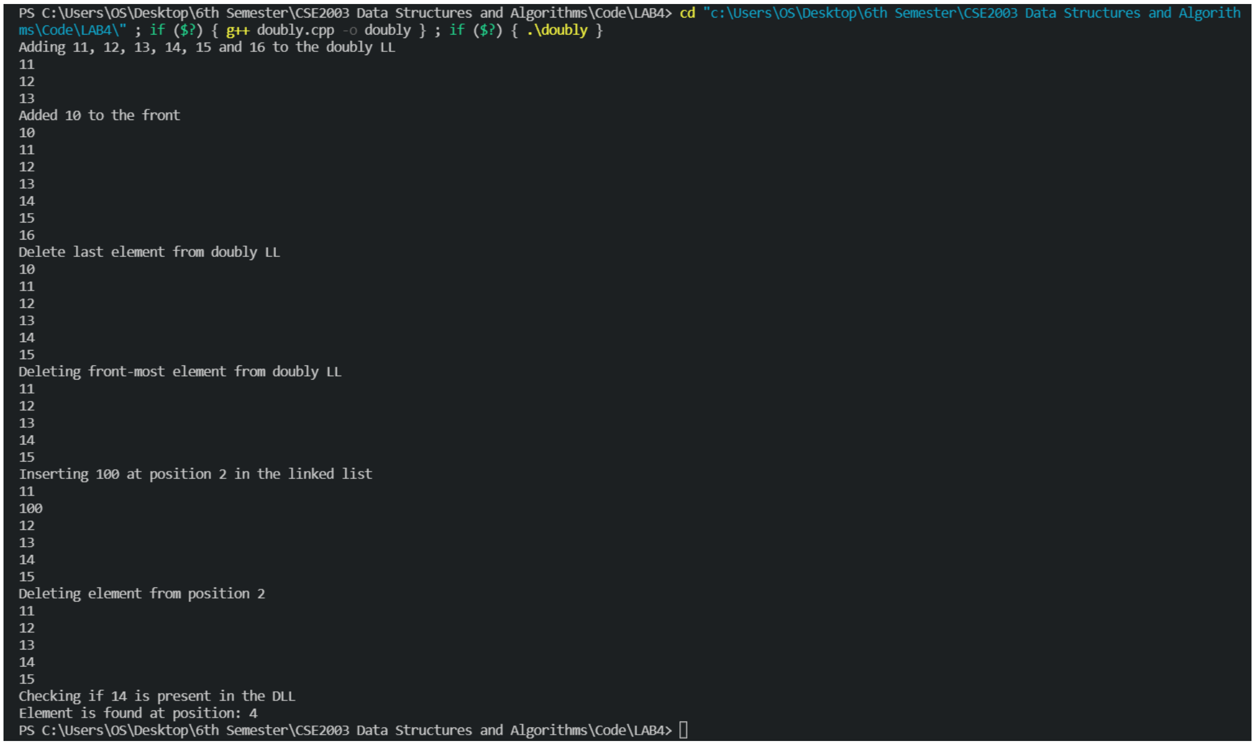


```
    for (int i = 1; i < position - 1; i++)
    {
        head = head->next;
    }
    struct Node *newNext = head->next->next;
    head->next = NULL;
    head->next = newNext;
    head = initial;
    return head;
}
void Print(struct Node *head)
{
    struct Node *n = head;
    while (head != NULL)
    {
        cout << head->data << endl;
        head = head->next;
    }
}
void Search(struct Node *head, int value)
{
    if (head == NULL)
    {
        cout << "DLL is empty!" << endl;
        return;
    }
    bool found = false;
    int position = 1;
    while (head->next != NULL)
    {
        if (head->data == value)
        {
            found = true;
            break;
        }
        else
        {
            head = head->next;
            position += 1;
            continue;
        }
    }
    if (found == true)
    {
        cout << "Element is found at position: " << position << endl;
```



```
    }
    else {
        cout << "Element not found!" << endl;
    }
    return;
}
int main()
{

    struct Node *head = new Node;
    head = NULL;
    cout << "Adding 11, 12, 13, 14, 15 and 16 to the doubly LL" << endl;
    head = InsertEnd(head, 11);
    head = InsertEnd(head, 12);
    head = InsertEnd(head, 13);
    head = InsertEnd(head, 14);
    head = InsertEnd(head, 15);
    head = InsertEnd(head, 16);
    Print(head);
    head = InsertFront(head, 10);
    cout << "Added 10 to the front" << endl;
    Print(head);
    cout << "Delete last element from doubly LL" << endl;
    head = DeleteLast(head);
    Print(head);
    cout << "Deleting front-most element from doubly LL" << endl;
    head = DeleteFront(head);
    Print(head);
    int data = 100;
    int position = 2;
    cout << "Inserting " << data << " at position " << position << " in the
linked list" << endl;
    head = InsertMiddle(head, data, position);
    Print(head);
    cout << "Deleting element from position " << position << endl;
    head = DeleteMiddle(head, position);
    Print(head);
    cout << "Checking if 14 is present in the DLL" << endl;
    Search(head, 14);
    return 0;
}
```

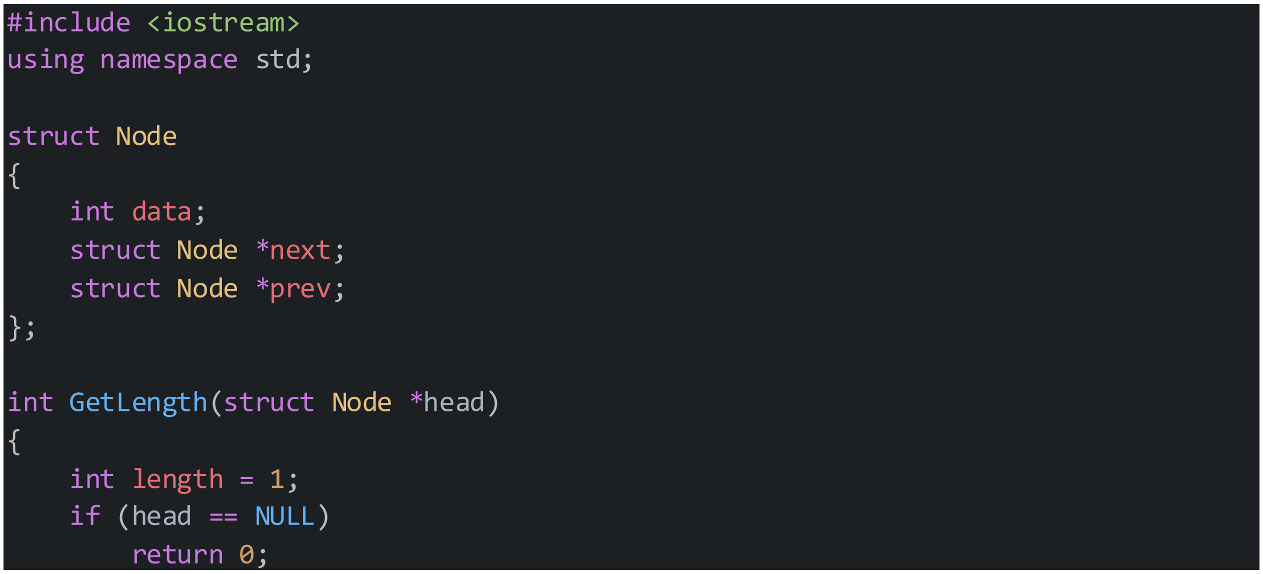
Output:



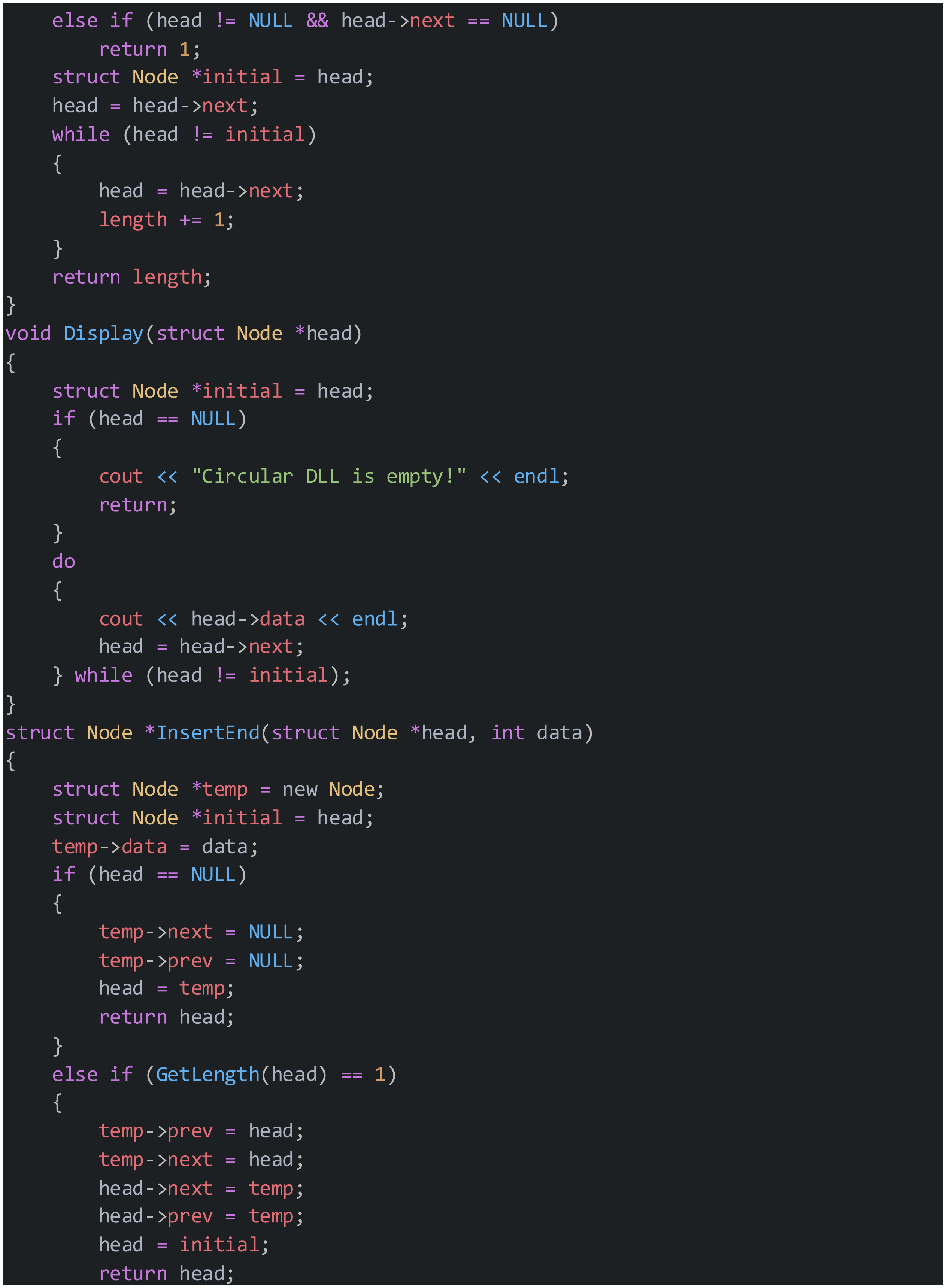
```
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> cd "c:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorith
ms\Code\LAB4\" ; if ($?) { g++ doubly.cpp -o doubly } ; if ($?) { .\doubly }
Adding 11, 12, 13, 14, 15 and 16 to the doubly LL
11
12
13
Added 10 to the front
10
11
12
13
14
15
16
Delete last element from doubly LL
10
11
12
13
14
15
Deleting front-most element from doubly LL
11
12
13
14
15
Inserting 100 at position 2 in the linked list
11
100
12
13
14
15
Deleting element from position 2
11
12
13
14
15
Checking if 14 is present in the DLL
Element is found at position: 4
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> 
```

Task 2: Create a circular doubly linked list and perform the operations as done above.

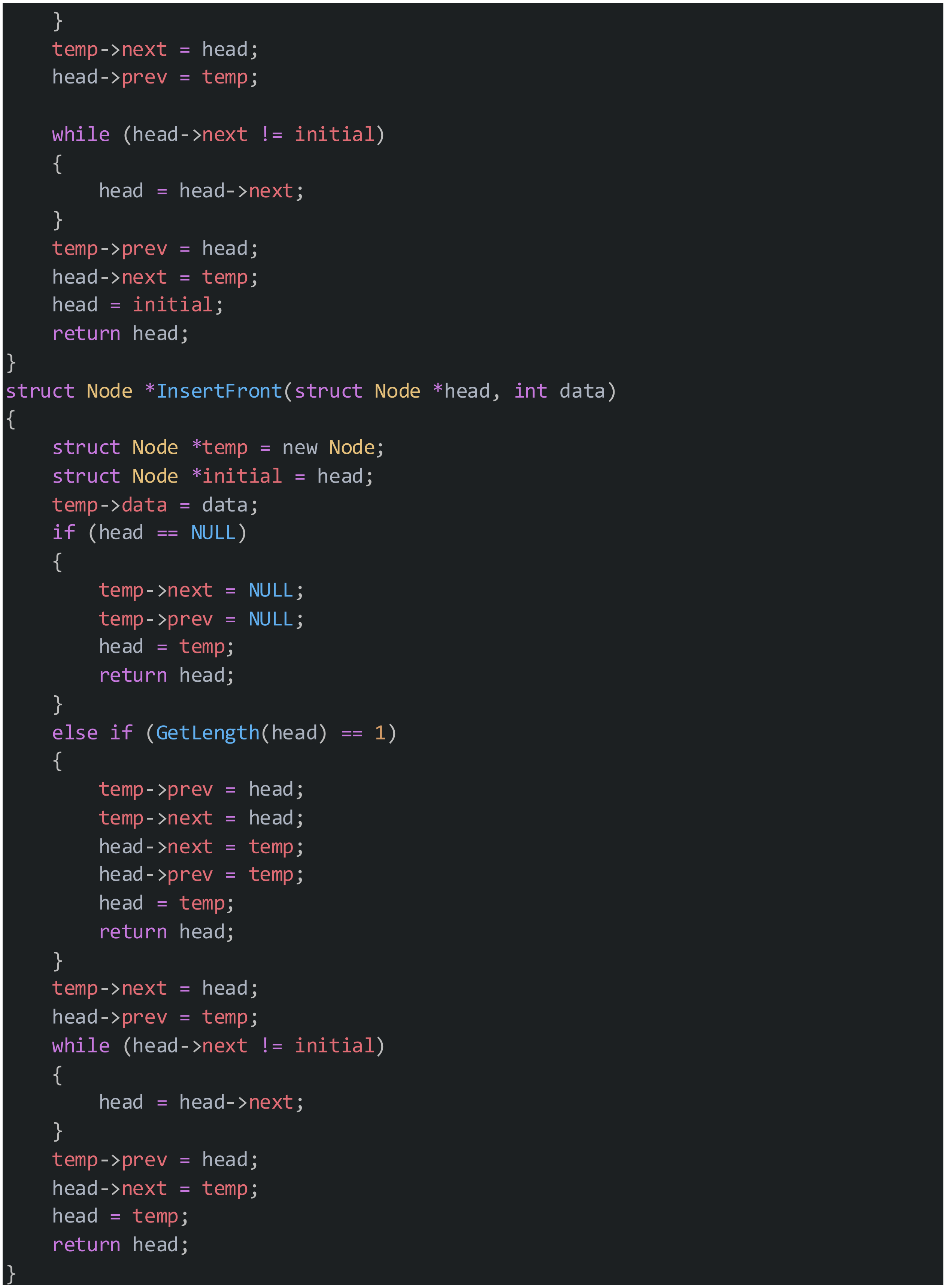
Code:



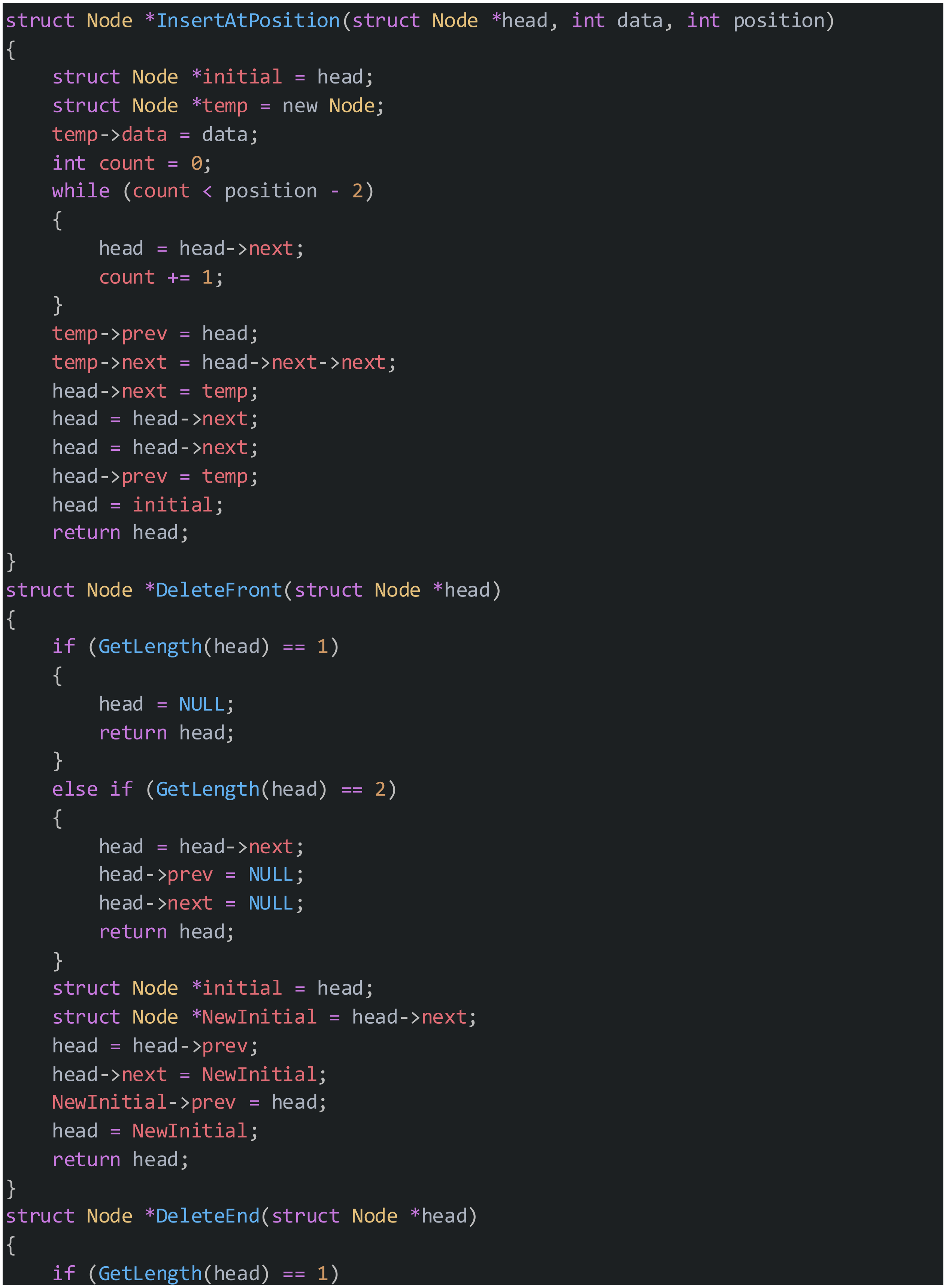
```cpp
#include <iostream>
using namespace std;

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

int GetLength(struct Node *head)
{
    int length = 1;
    if (head == NULL)
        return 0;
```



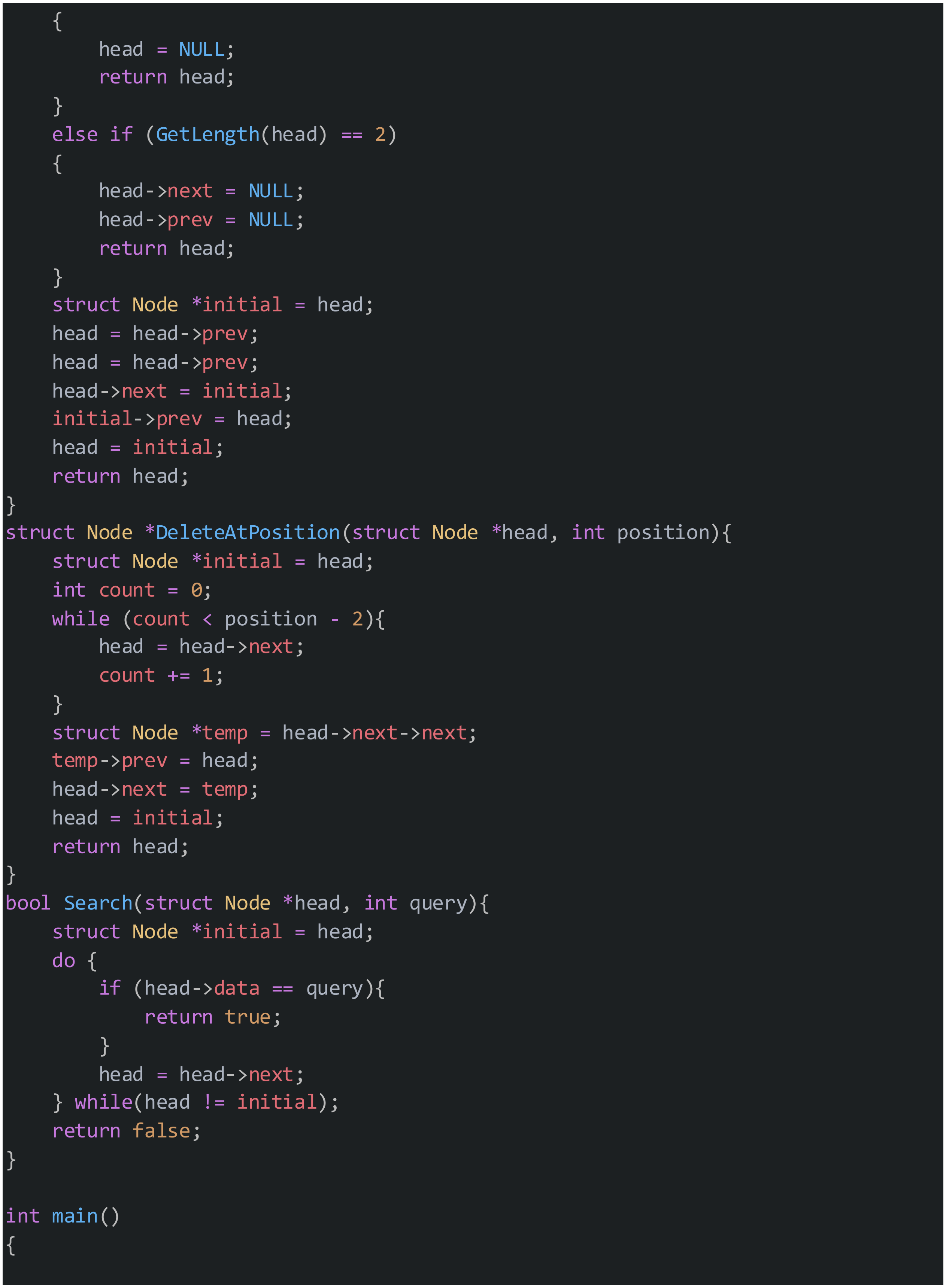
```
    else if (head != NULL && head->next == NULL)
        return 1;
    struct Node *initial = head;
    head = head->next;
    while (head != initial)
    {
        head = head->next;
        length += 1;
    }
    return length;
}
void Display(struct Node *head)
{
    struct Node *initial = head;
    if (head == NULL)
    {
        cout << "Circular DLL is empty!" << endl;
        return;
    }
    do
    {
        cout << head->data << endl;
        head = head->next;
    } while (head != initial);
}
struct Node *InsertEnd(struct Node *head, int data)
{
    struct Node *temp = new Node;
    struct Node *initial = head;
    temp->data = data;
    if (head == NULL)
    {
        temp->next = NULL;
        temp->prev = NULL;
        head = temp;
        return head;
    }
    else if (GetLength(head) == 1)
    {
        temp->prev = head;
        temp->next = head;
        head->next = temp;
        head->prev = temp;
        head = initial;
        return head;
```



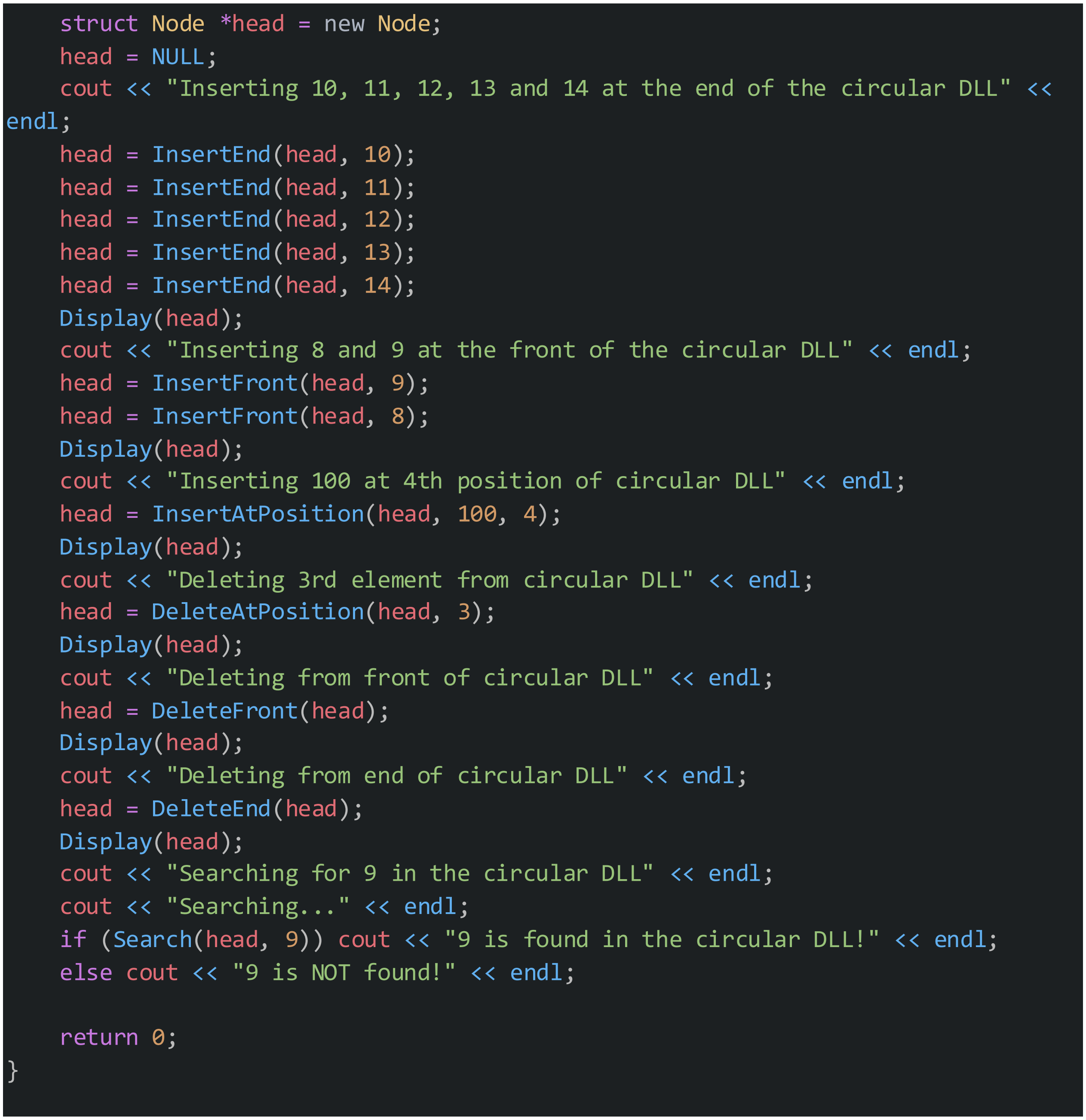
```
    }
    temp->next = head;
    head->prev = temp;

    while (head->next != initial)
    {
        head = head->next;
    }
    temp->prev = head;
    head->next = temp;
    head = initial;
    return head;
}
struct Node *InsertFront(struct Node *head, int data)
{
    struct Node *temp = new Node;
    struct Node *initial = head;
    temp->data = data;
    if (head == NULL)
    {
        temp->next = NULL;
        temp->prev = NULL;
        head = temp;
        return head;
    }
    else if (GetLength(head) == 1)
    {
        temp->prev = head;
        temp->next = head;
        head->next = temp;
        head->prev = temp;
        head = temp;
        return head;
    }
    temp->next = head;
    head->prev = temp;
    while (head->next != initial)
    {
        head = head->next;
    }
    temp->prev = head;
    head->next = temp;
    head = temp;
    return head;
}
```



```
struct Node *InsertAtPosition(struct Node *head, int data, int position)
{
    struct Node *initial = head;
    struct Node *temp = new Node;
    temp->data = data;
    int count = 0;
    while (count < position - 2)
    {
        head = head->next;
        count += 1;
    }
    temp->prev = head;
    temp->next = head->next->next;
    head->next = temp;
    head = head->next;
    head = head->next;
    head->prev = temp;
    head = initial;
    return head;
}
struct Node *DeleteFront(struct Node *head)
{
    if (GetLength(head) == 1)
    {
        head = NULL;
        return head;
    }
    else if (GetLength(head) == 2)
    {
        head = head->next;
        head->prev = NULL;
        head->next = NULL;
        return head;
    }
    struct Node *initial = head;
    struct Node *NewInitial = head->next;
    head = head->prev;
    head->next = NewInitial;
    NewInitial->prev = head;
    head = NewInitial;
    return head;
}
struct Node *DeleteEnd(struct Node *head)
{
    if (GetLength(head) == 1)
```

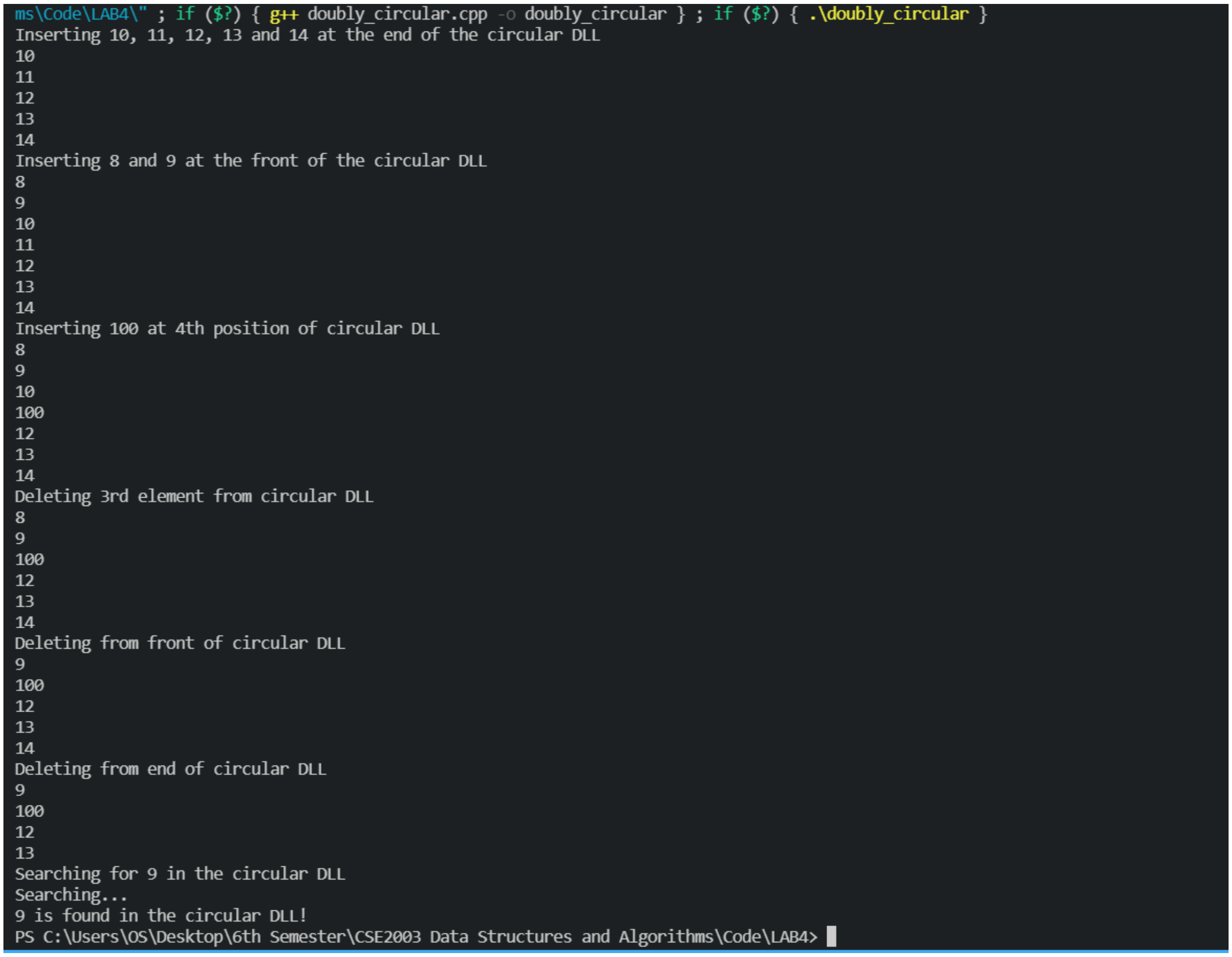


```
    {
        head = NULL;
        return head;
    }
    else if (GetLength(head) == 2)
    {
        head->next = NULL;
        head->prev = NULL;
        return head;
    }
    struct Node *initial = head;
    head = head->prev;
    head = head->prev;
    head->next = initial;
    initial->prev = head;
    head = initial;
    return head;
}
struct Node *DeleteAtPosition(struct Node *head, int position){
    struct Node *initial = head;
    int count = 0;
    while (count < position - 2){
        head = head->next;
        count += 1;
    }
    struct Node *temp = head->next->next;
    temp->prev = head;
    head->next = temp;
    head = initial;
    return head;
}
bool Search(struct Node *head, int query){
    struct Node *initial = head;
    do {
        if (head->data == query){
            return true;
        }
        head = head->next;
    } while(head != initial);
    return false;
}

int main()
{
```



```
    struct Node *head = new Node;
    head = NULL;
    cout << "Inserting 10, 11, 12, 13 and 14 at the end of the circular DLL" <<
endl;
    head = InsertEnd(head, 10);
    head = InsertEnd(head, 11);
    head = InsertEnd(head, 12);
    head = InsertEnd(head, 13);
    head = InsertEnd(head, 14);
    Display(head);
    cout << "Inserting 8 and 9 at the front of the circular DLL" << endl;
    head = InsertFront(head, 9);
    head = InsertFront(head, 8);
    Display(head);
    cout << "Inserting 100 at 4th position of circular DLL" << endl;
    head = InsertAtPosition(head, 100, 4);
    Display(head);
    cout << "Deleting 3rd element from circular DLL" << endl;
    head = DeleteAtPosition(head, 3);
    Display(head);
    cout << "Deleting from front of circular DLL" << endl;
    head = DeleteFront(head);
    Display(head);
    cout << "Deleting from end of circular DLL" << endl;
    head = DeleteEnd(head);
    Display(head);
    cout << "Searching for 9 in the circular DLL" << endl;
    cout << "Searching..." << endl;
    if (Search(head, 9)) cout << "9 is found in the circular DLL!" << endl;
    else cout << "9 is NOT found!" << endl;

    return 0;
}
```

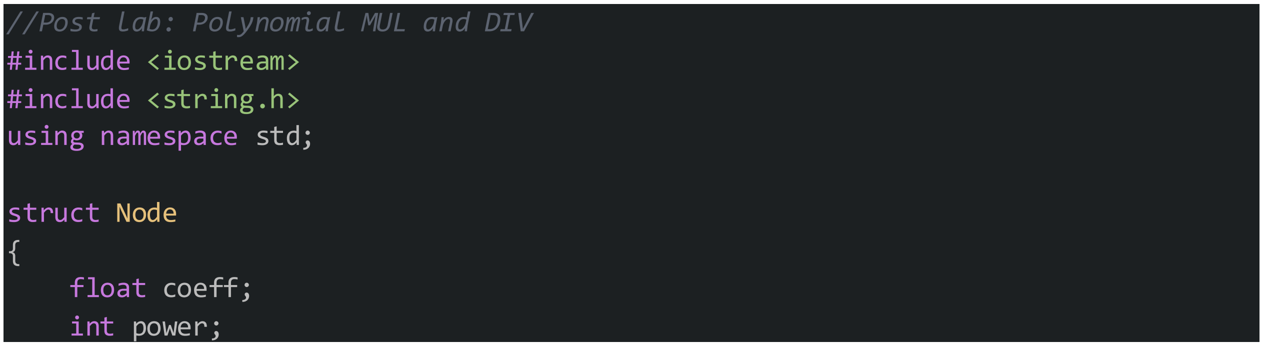
Output:



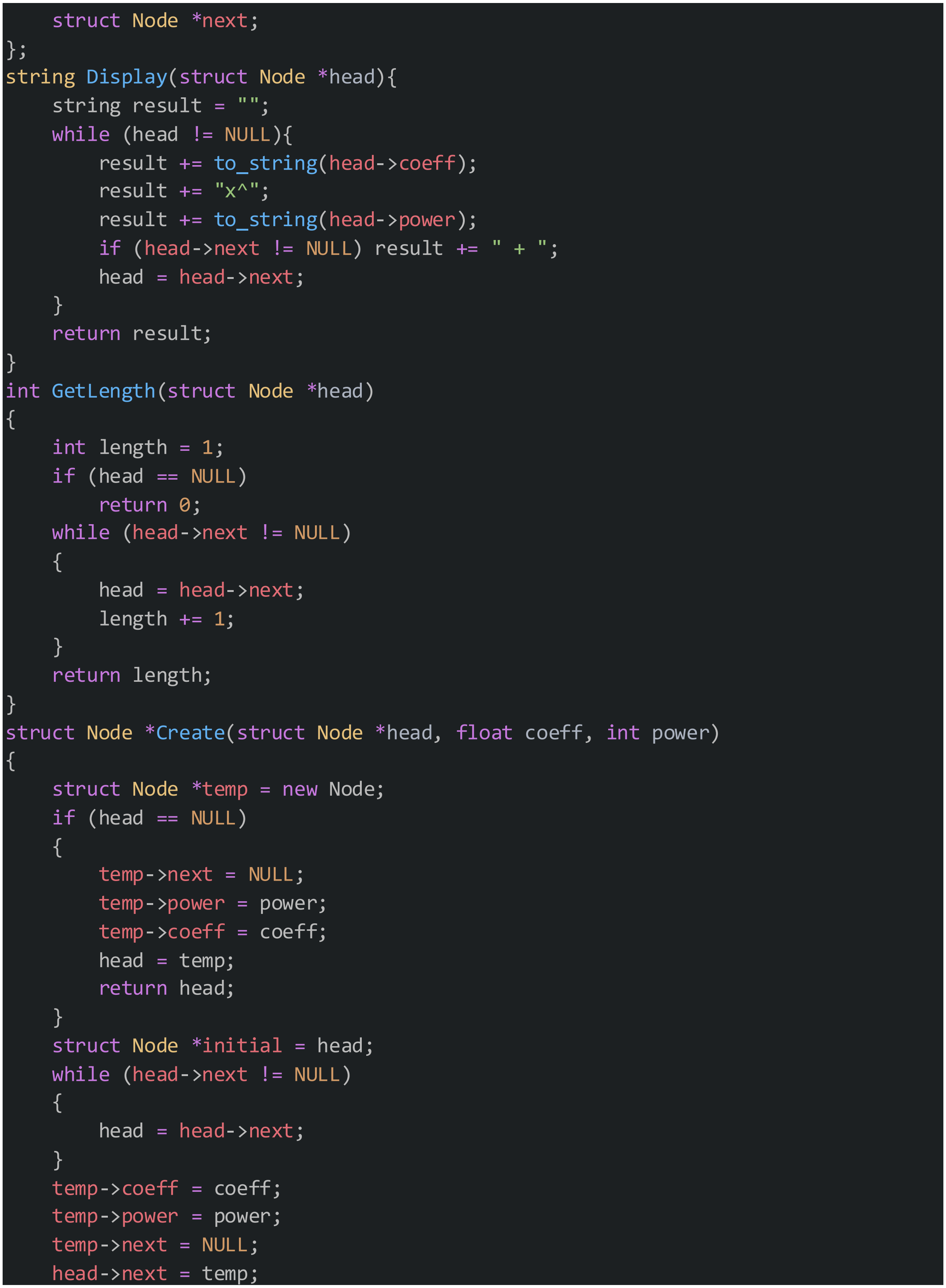
```
ms\Code\LAB4\" ; if ($?) { g++ doubly_circular.cpp -o doubly_circular } ; if ($?) { .\doubly_circular }
Inserting 10, 11, 12, 13 and 14 at the end of the circular DLL
10
11
12
13
14
Inserting 8 and 9 at the front of the circular DLL
8
9
10
11
12
13
14
Inserting 100 at 4th position of circular DLL
8
9
10
100
12
13
14
Deleting 3rd element from circular DLL
8
9
100
12
13
14
Deleting from front of circular DLL
9
100
12
13
14
Deleting from end of circular DLL
9
100
12
13
Searching for 9 in the circular DLL
Searching...
9 is found in the circular DLL!
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> 
```

Task 3: Using linked lists, perform addition, subtraction, multiplication and division of polynomials.

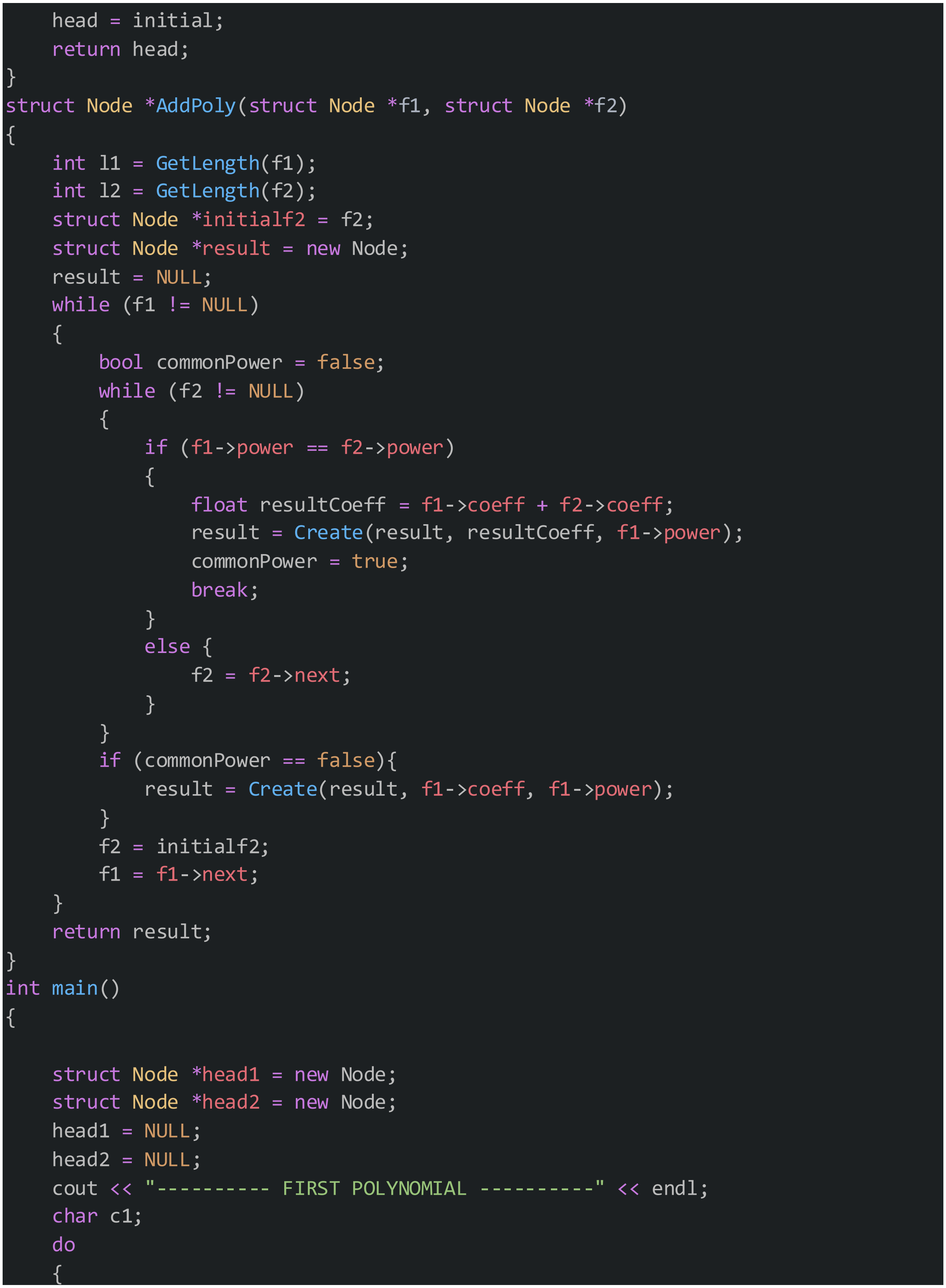
Code for addition:



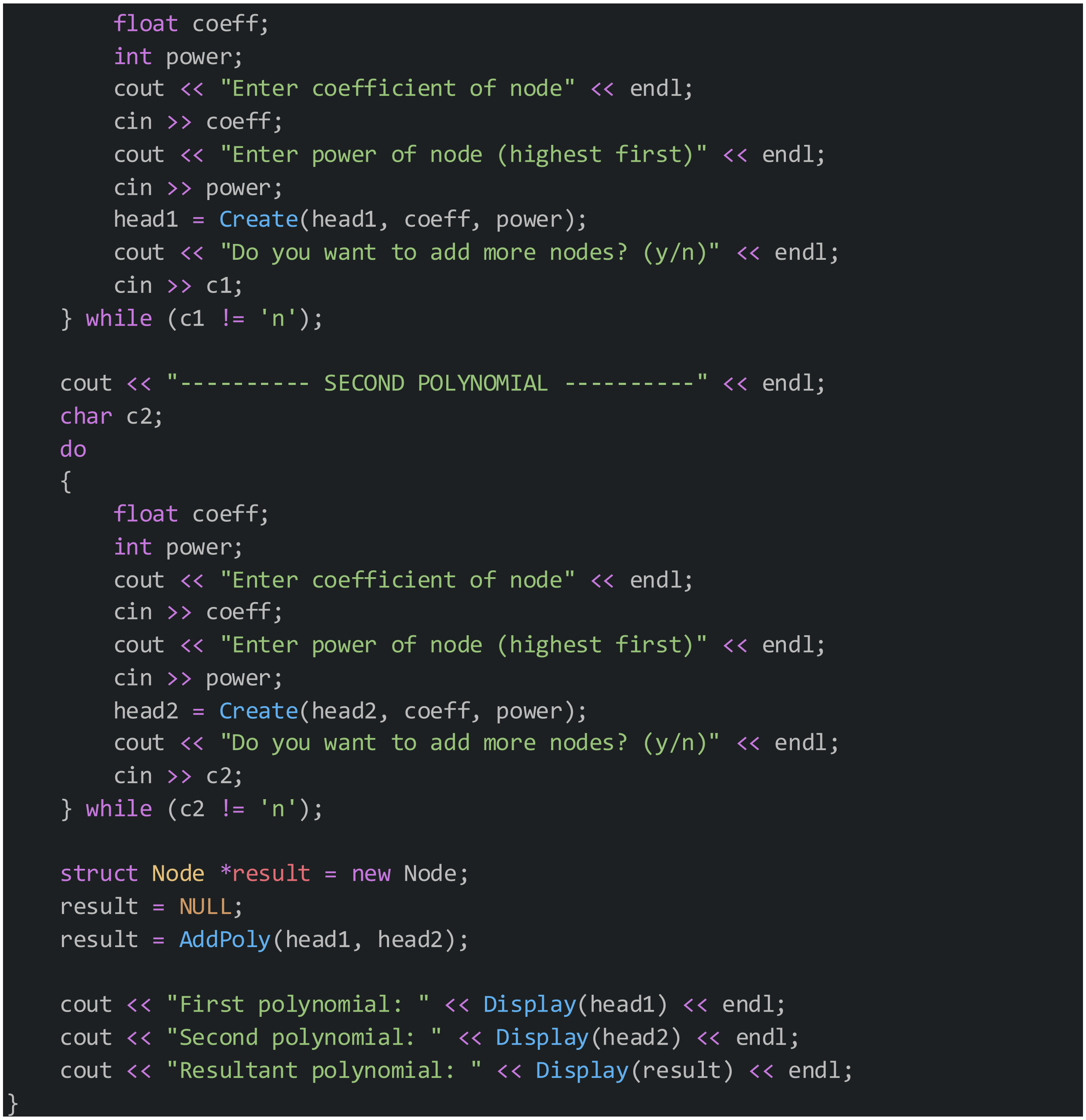
```
//Post lab: Polynomial MUL and DIV
#include <iostream>
#include <string.h>
using namespace std;

struct Node
{
    float coeff;
    int power;
```



```
    struct Node *next;
};
string Display(struct Node *head){
    string result = "";
    while (head != NULL){
        result += to_string(head->coeff);
        result += "x^";
        result += to_string(head->power);
        if (head->next != NULL) result += " + ";
        head = head->next;
    }
    return result;
}
int GetLength(struct Node *head)
{
    int length = 1;
    if (head == NULL)
        return 0;
    while (head->next != NULL)
    {
        head = head->next;
        length += 1;
    }
    return length;
}
struct Node *Create(struct Node *head, float coeff, int power)
{
    struct Node *temp = new Node;
    if (head == NULL)
    {
        temp->next = NULL;
        temp->power = power;
        temp->coeff = coeff;
        head = temp;
        return head;
    }
    struct Node *initial = head;
    while (head->next != NULL)
    {
        head = head->next;
    }
    temp->coeff = coeff;
    temp->power = power;
    temp->next = NULL;
    head->next = temp;
```

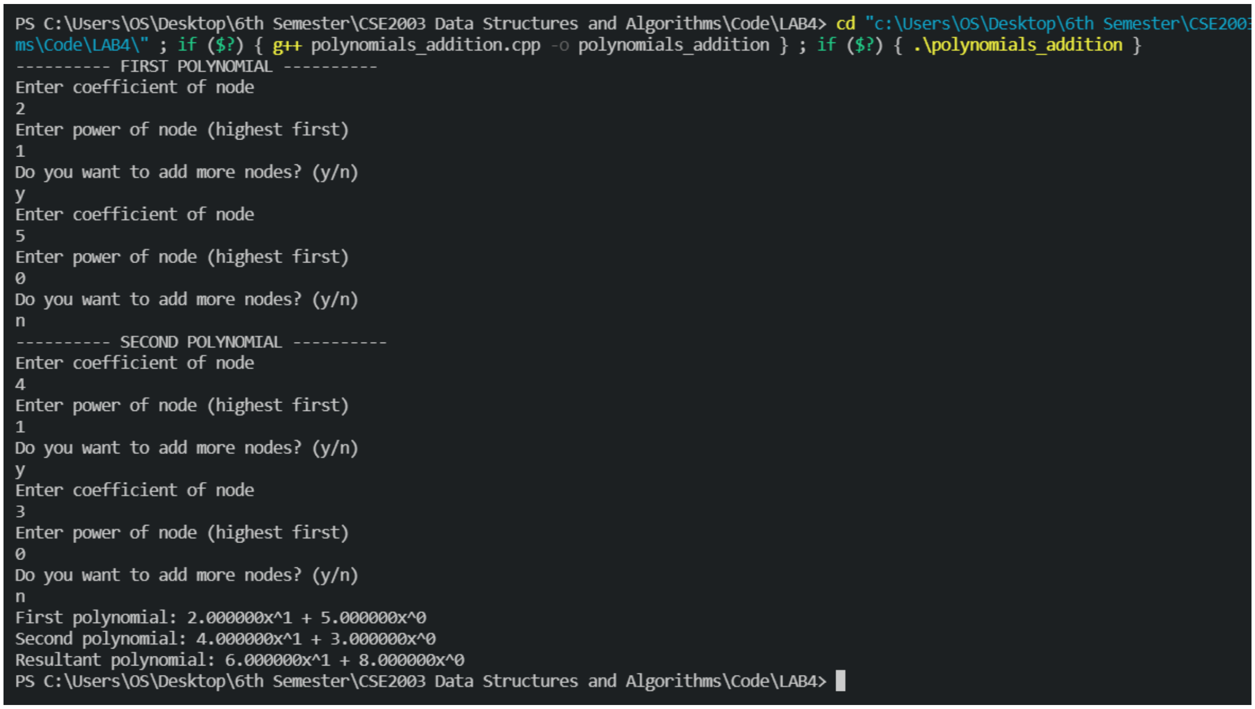


```
    head = initial;
    return head;
}
struct Node *AddPoly(struct Node *f1, struct Node *f2)
{
    int l1 = GetLength(f1);
    int l2 = GetLength(f2);
    struct Node *initialf2 = f2;
    struct Node *result = new Node;
    result = NULL;
    while (f1 != NULL)
    {
        bool commonPower = false;
        while (f2 != NULL)
        {
            if (f1->power == f2->power)
            {
                float resultCoeff = f1->coeff + f2->coeff;
                result = Create(result, resultCoeff, f1->power);
                commonPower = true;
                break;
            }
            else {
                f2 = f2->next;
            }
        }
        if (commonPower == false){
            result = Create(result, f1->coeff, f1->power);
        }
        f2 = initialf2;
        f1 = f1->next;
    }
    return result;
}
int main()
{

    struct Node *head1 = new Node;
    struct Node *head2 = new Node;
    head1 = NULL;
    head2 = NULL;
    cout << "---------- FIRST POLYNOMIAL ----------" << endl;
    char c1;
    do
    {
```



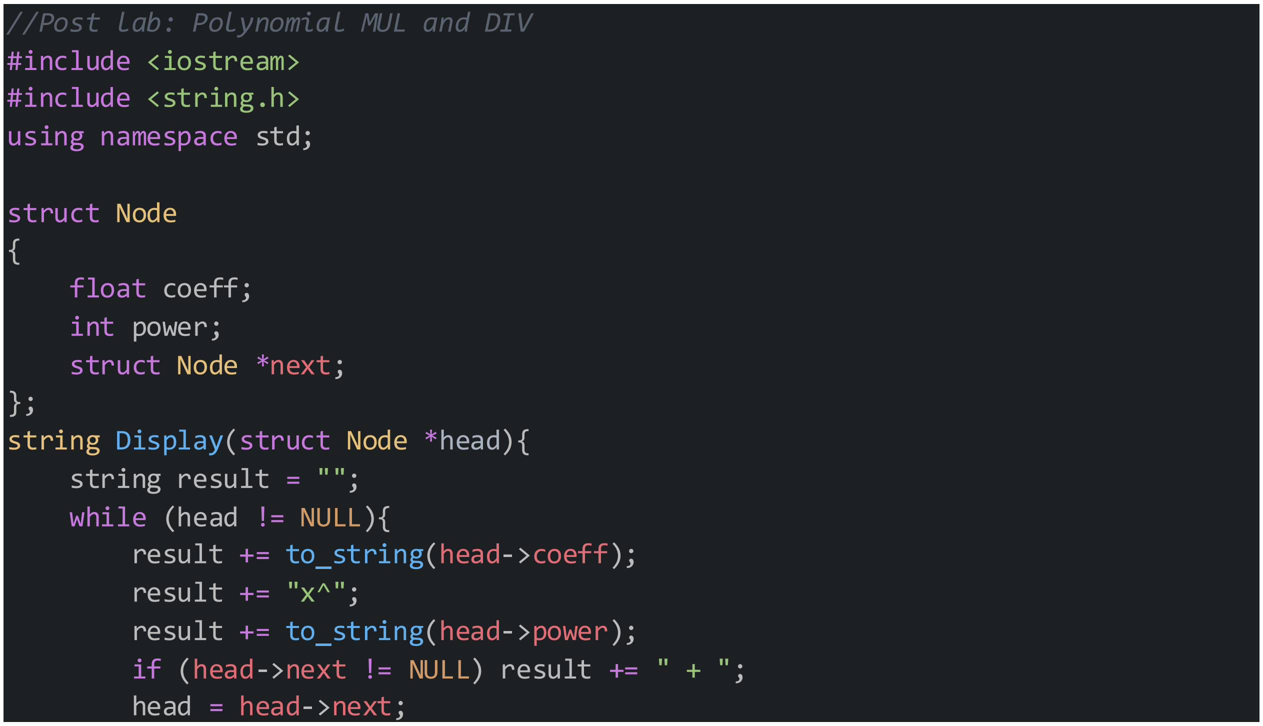
```
        float coeff;
        int power;
        cout << "Enter coefficient of node" << endl;
        cin >> coeff;
        cout << "Enter power of node (highest first)" << endl;
        cin >> power;
        head1 = Create(head1, coeff, power);
        cout << "Do you want to add more nodes? (y/n)" << endl;
        cin >> c1;
    } while (c1 != 'n');

    cout << "---------- SECOND POLYNOMIAL ----------" << endl;
    char c2;
    do
    {
        float coeff;
        int power;
        cout << "Enter coefficient of node" << endl;
        cin >> coeff;
        cout << "Enter power of node (highest first)" << endl;
        cin >> power;
        head2 = Create(head2, coeff, power);
        cout << "Do you want to add more nodes? (y/n)" << endl;
        cin >> c2;
    } while (c2 != 'n');

    struct Node *result = new Node;
    result = NULL;
    result = AddPoly(head1, head2);

    cout << "First polynomial: " << Display(head1) << endl;
    cout << "Second polynomial: " << Display(head2) << endl;
    cout << "Resultant polynomial: " << Display(result) << endl;
}
```

Output for addition:

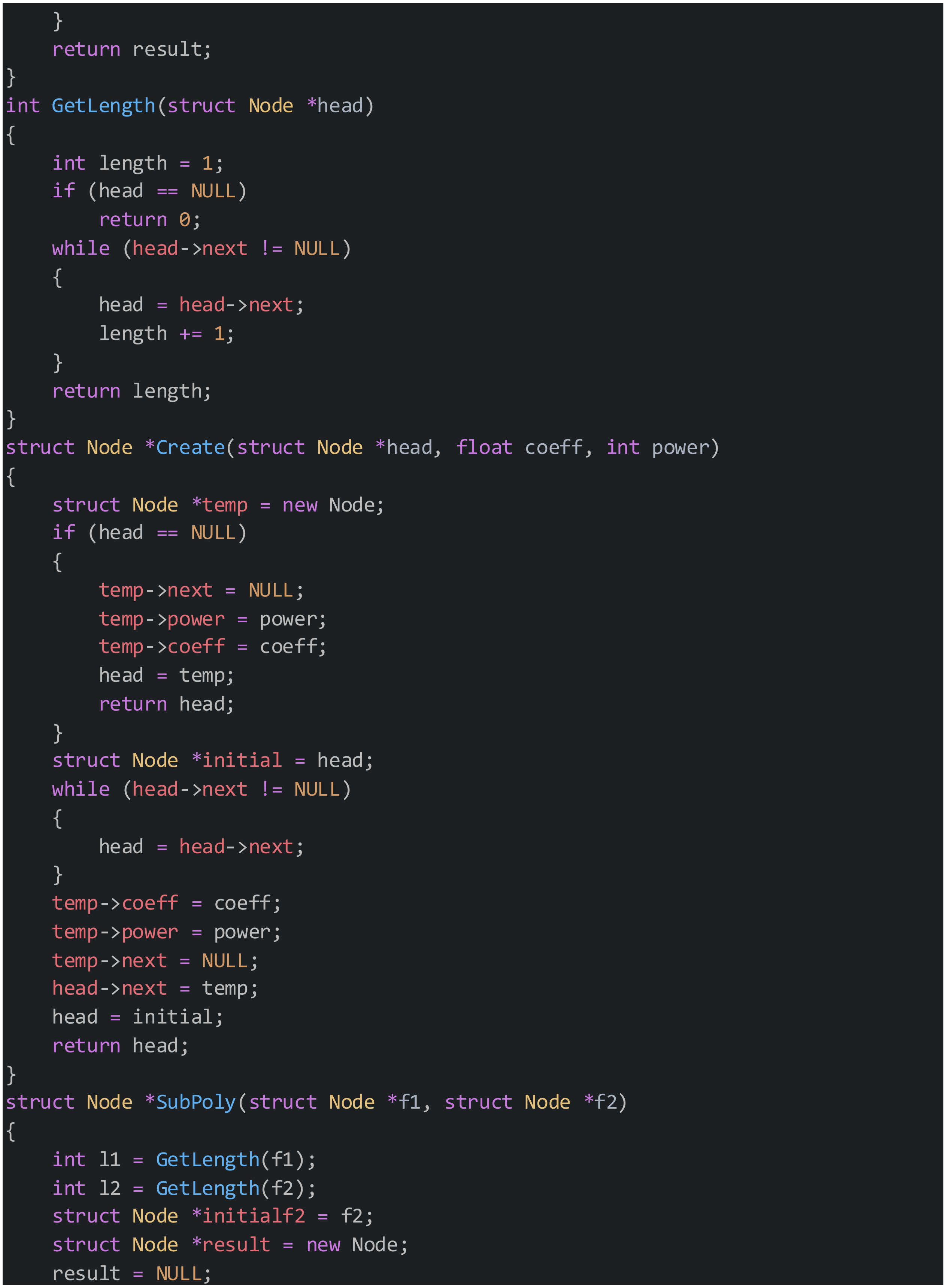


```
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> cd "c:\Users\OS\Desktop\6th Semester\CSE200
ms\Code\LAB4\" ; if ($?) { g++ polynomials_addition.cpp -o polynomials_addition } ; if ($?) { .\polynomials_addition }
---------- FIRST POLYNOMIAL ----------
Enter coefficient of node
2
Enter power of node (highest first)
1
Do you want to add more nodes? (y/n)
y
Enter coefficient of node
5
Enter power of node (highest first)
0
Do you want to add more nodes? (y/n)
n
---------- SECOND POLYNOMIAL ----------
Enter coefficient of node
4
Enter power of node (highest first)
1
Do you want to add more nodes? (y/n)
y
Enter coefficient of node
3
Enter power of node (highest first)
0
Do you want to add more nodes? (y/n)
n
First polynomial: 2.000000x^1 + 5.000000x^0
Second polynomial: 4.000000x^1 + 3.000000x^0
Resultant polynomial: 6.000000x^1 + 8.000000x^0
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> 
```

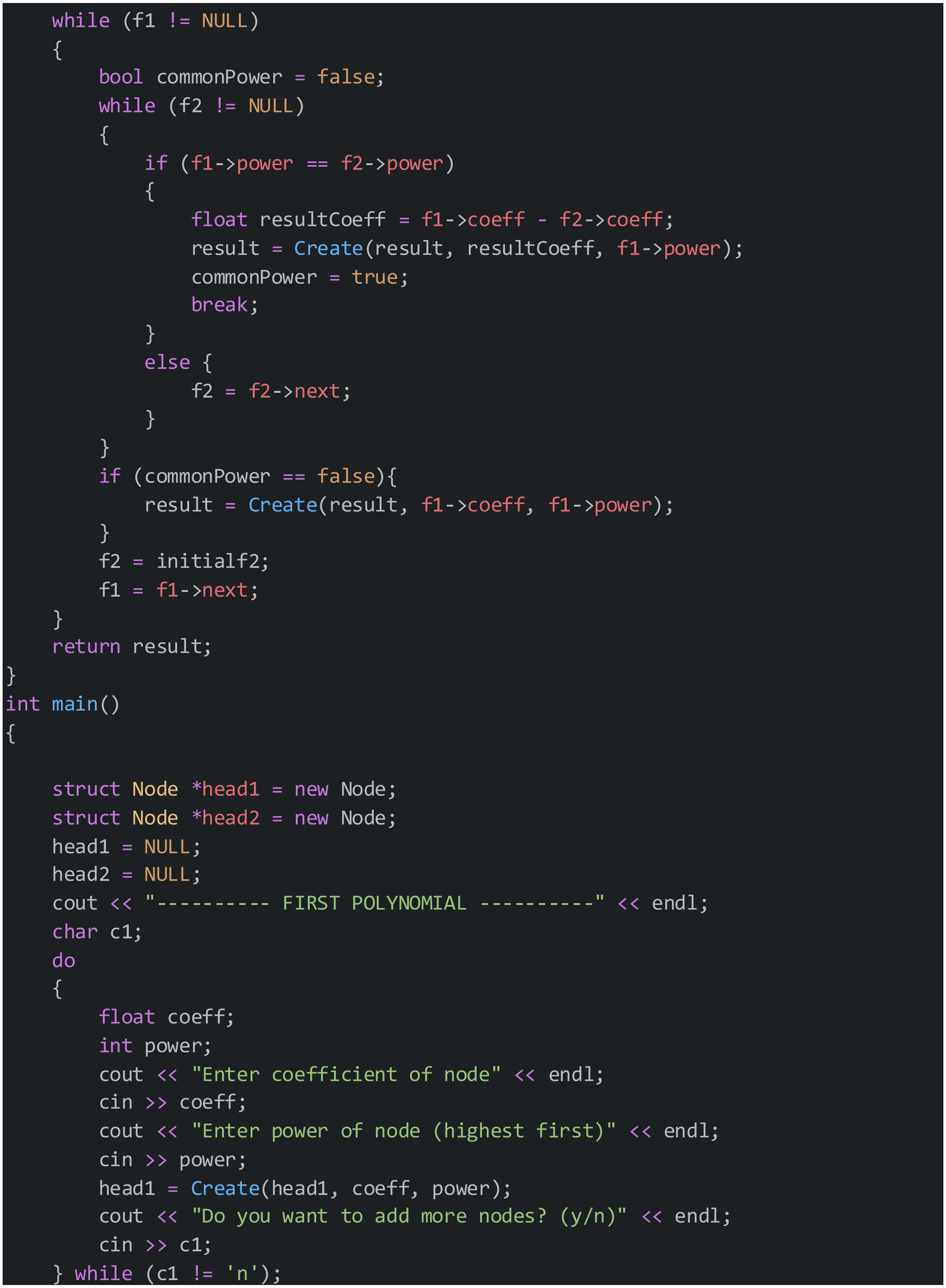
Code for subtraction:



```
//Post lab: Polynomial MUL and DIV
#include <iostream>
#include <string.h>
using namespace std;

struct Node
{
    float coeff;
    int power;
    struct Node *next;
};
string Display(struct Node *head){
    string result = "";
    while (head != NULL){
        result += to_string(head->coeff);
        result += "x^";
        result += to_string(head->power);
        if (head->next != NULL) result += " + ";
        head = head->next;
```

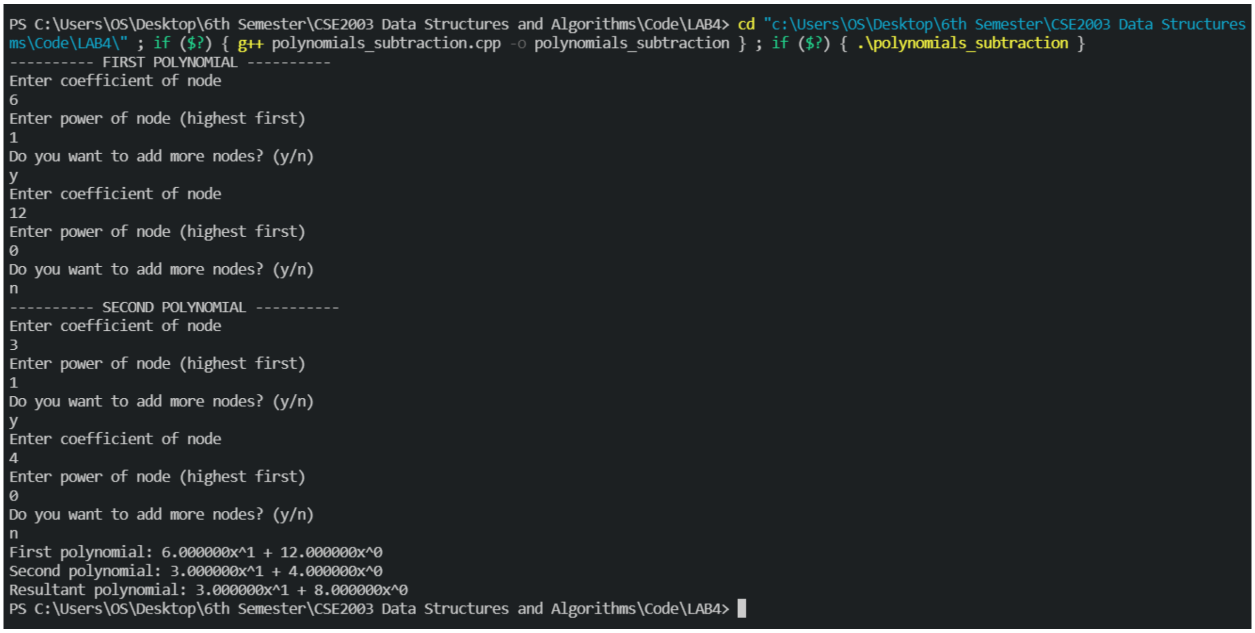


```
    }
    return result;
}
int GetLength(struct Node *head)
{
    int length = 1;
    if (head == NULL)
        return 0;
    while (head->next != NULL)
    {
        head = head->next;
        length += 1;
    }
    return length;
}
struct Node *Create(struct Node *head, float coeff, int power)
{
    struct Node *temp = new Node;
    if (head == NULL)
    {
        temp->next = NULL;
        temp->power = power;
        temp->coeff = coeff;
        head = temp;
        return head;
    }
    struct Node *initial = head;
    while (head->next != NULL)
    {
        head = head->next;
    }
    temp->coeff = coeff;
    temp->power = power;
    temp->next = NULL;
    head->next = temp;
    head = initial;
    return head;
}
struct Node *SubPoly(struct Node *f1, struct Node *f2)
{
    int l1 = GetLength(f1);
    int l2 = GetLength(f2);
    struct Node *initialf2 = f2;
    struct Node *result = new Node;
    result = NULL;
```



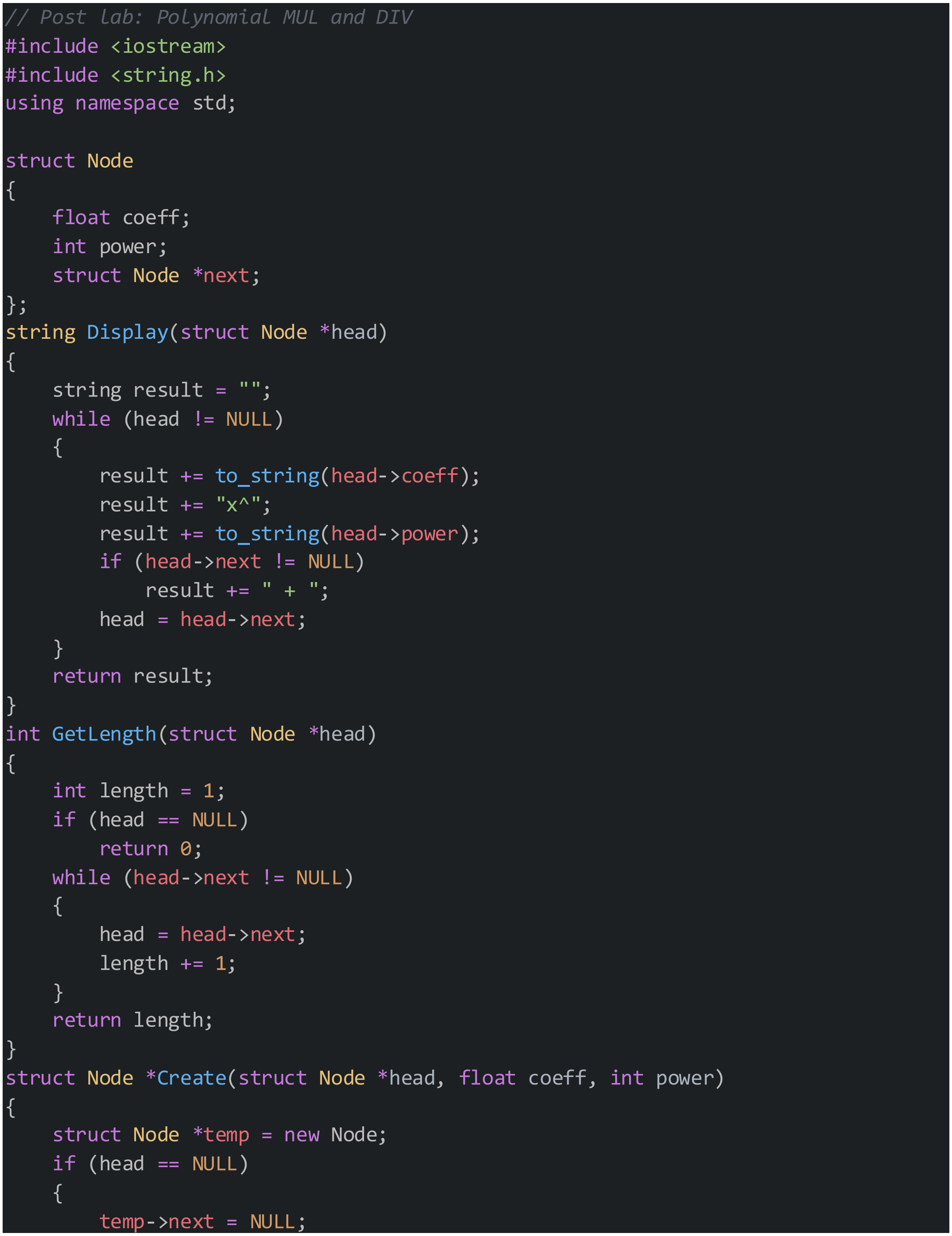
```
    while (f1 != NULL)
    {
        bool commonPower = false;
        while (f2 != NULL)
        {
            if (f1->power == f2->power)
            {
                float resultCoeff = f1->coeff - f2->coeff;
                result = Create(result, resultCoeff, f1->power);
                commonPower = true;
                break;
            }
            else {
                f2 = f2->next;
            }
        }
        if (commonPower == false){
            result = Create(result, f1->coeff, f1->power);
        }
        f2 = initialf2;
        f1 = f1->next;
    }
    return result;
}
int main()
{

    struct Node *head1 = new Node;
    struct Node *head2 = new Node;
    head1 = NULL;
    head2 = NULL;
    cout << "---------- FIRST POLYNOMIAL ----------" << endl;
    char c1;
    do
    {
        float coeff;
        int power;
        cout << "Enter coefficient of node" << endl;
        cin >> coeff;
        cout << "Enter power of node (highest first)" << endl;
        cin >> power;
        head1 = Create(head1, coeff, power);
        cout << "Do you want to add more nodes? (y/n)" << endl;
        cin >> c1;
    } while (c1 != 'n');
    cout << "---------- SECOND POLYNOMIAL ----------" << endl;
    char c2;
    do
    {
        float coeff;
        int power;
        cout << "Enter coefficient of node" << endl;
        cin >> coeff;
        cout << "Enter power of node (highest first)" << endl;
        cin >> power;
        head2 = Create(head2, coeff, power);
        cout << "Do you want to add more nodes? (y/n)" << endl;
        cin >> c2;
    } while (c2 != 'n');

    struct Node *result = new Node;
    result = NULL;
    result = SubPoly(head1, head2);

    cout << "First polynomial: " << Display(head1) << endl;
    cout << "Second polynomial: " << Display(head2) << endl;
    cout << "Resultant polynomial: " << Display(result) << endl;
}
```

Output for subtraction:

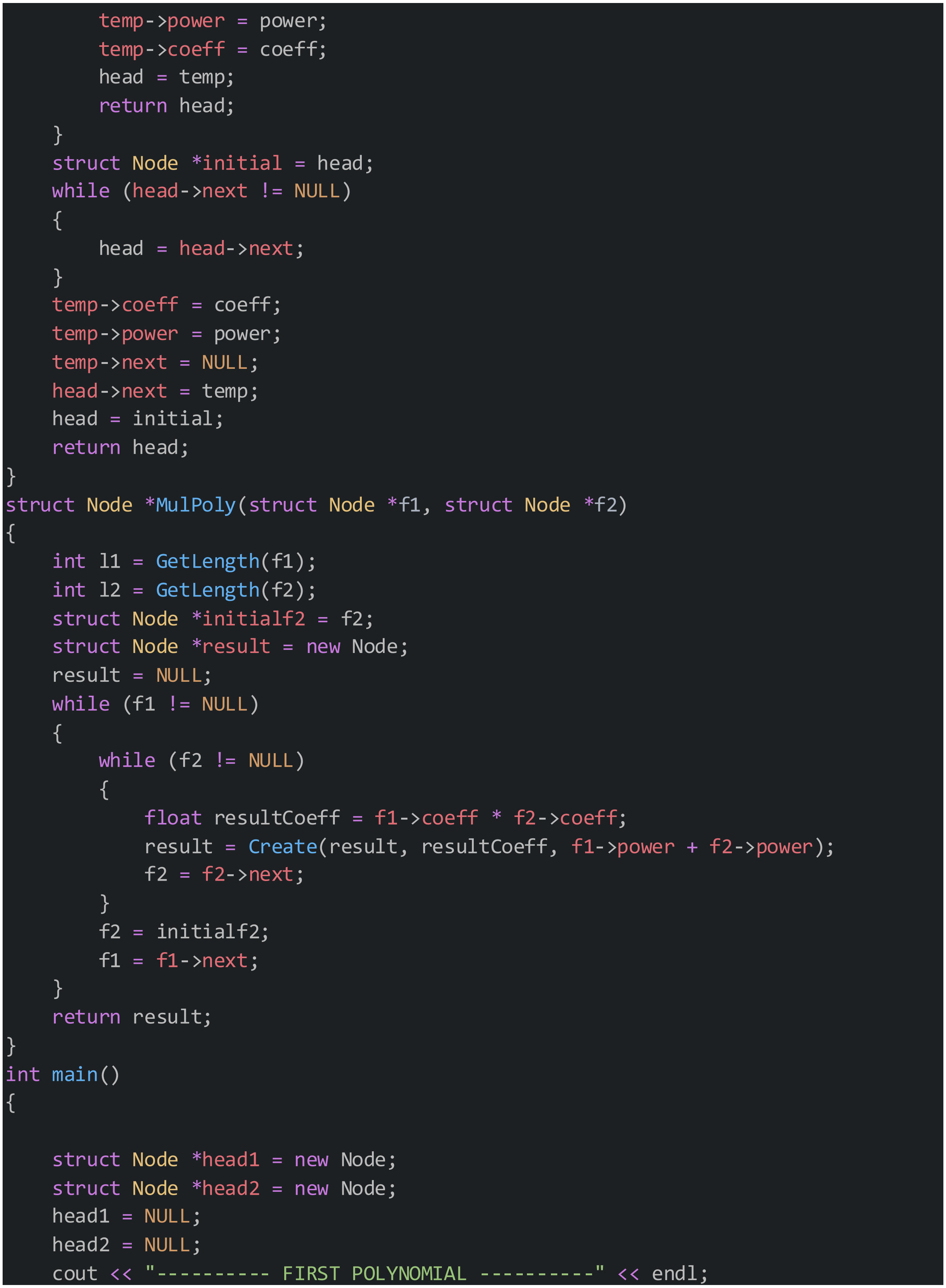


```
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> cd "c:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures
ms\Code\LAB4\" ; if ($?) { g++ polynomials_subtraction.cpp -o polynomials_subtraction } ; if ($?) { .\polynomials_subtraction }
---------- FIRST POLYNOMIAL ----------
Enter coefficient of node
6
Enter power of node (highest first)
1
Do you want to add more nodes? (y/n)
y
Enter coefficient of node
12
Enter power of node (highest first)
0
Do you want to add more nodes? (y/n)
n
---------- SECOND POLYNOMIAL ----------
Enter coefficient of node
3
Enter power of node (highest first)
1
Do you want to add more nodes? (y/n)
y
Enter coefficient of node
4
Enter power of node (highest first)
0
Do you want to add more nodes? (y/n)
n
First polynomial: 6.000000x^1 + 12.000000x^0
Second polynomial: 3.000000x^1 + 4.000000x^0
Resultant polynomial: 3.000000x^1 + 8.000000x^0
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> 
```

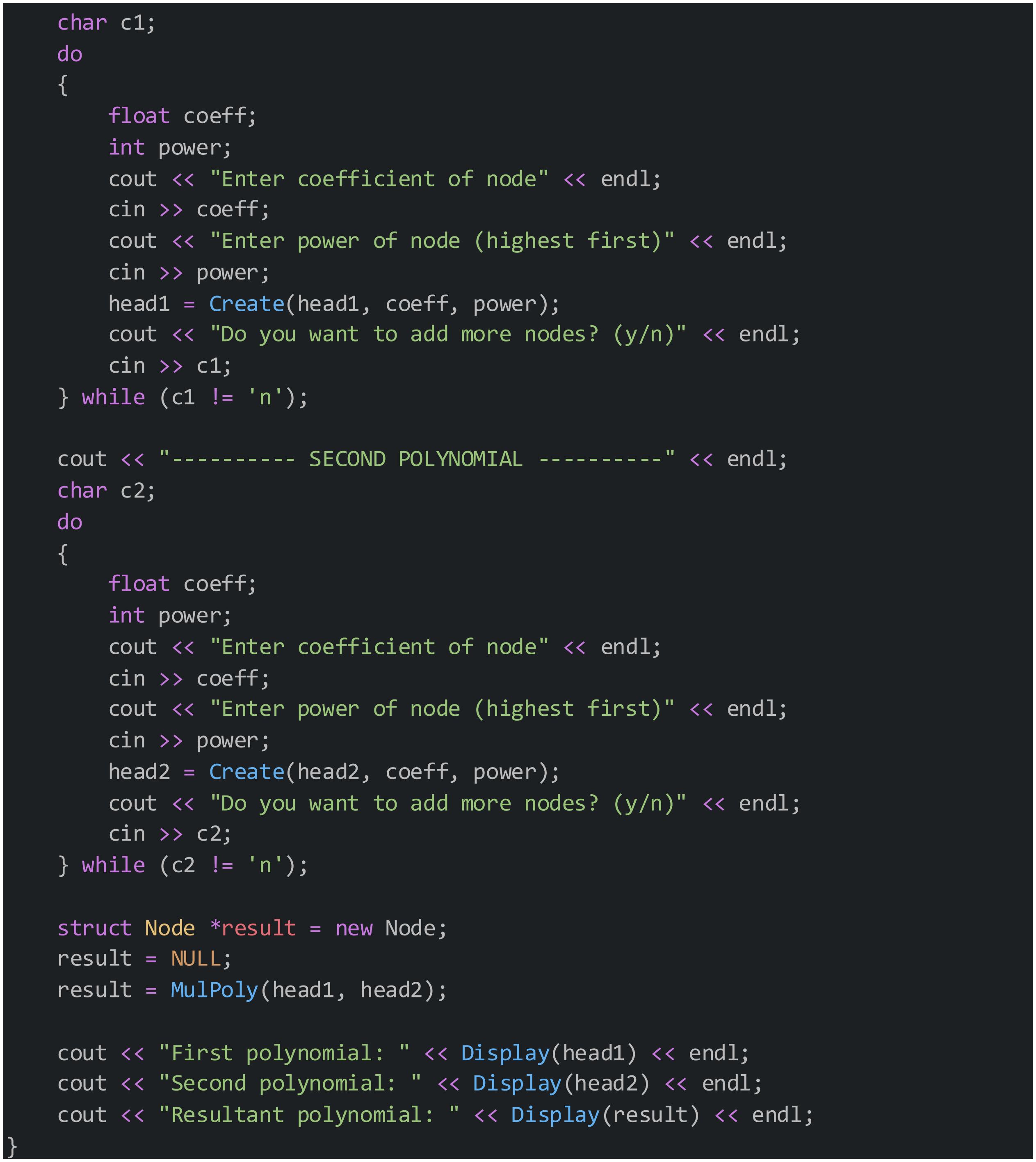
Code for multiplication:



```
// Post lab: Polynomial MUL and DIV
#include <iostream>
#include <string.h>
using namespace std;

struct Node
{
    float coeff;
    int power;
    struct Node *next;
};
string Display(struct Node *head)
{
    string result = "";
    while (head != NULL)
    {
        result += to_string(head->coeff);
        result += "x^";
        result += to_string(head->power);
        if (head->next != NULL)
            result += " + ";
        head = head->next;
    }
    return result;
}
int GetLength(struct Node *head)
{
    int length = 1;
    if (head == NULL)
        return 0;
    while (head->next != NULL)
    {
        head = head->next;
        length += 1;
    }
    return length;
}
struct Node *Create(struct Node *head, float coeff, int power)
{
    struct Node *temp = new Node;
    if (head == NULL)
    {
        temp->next = NULL;
```

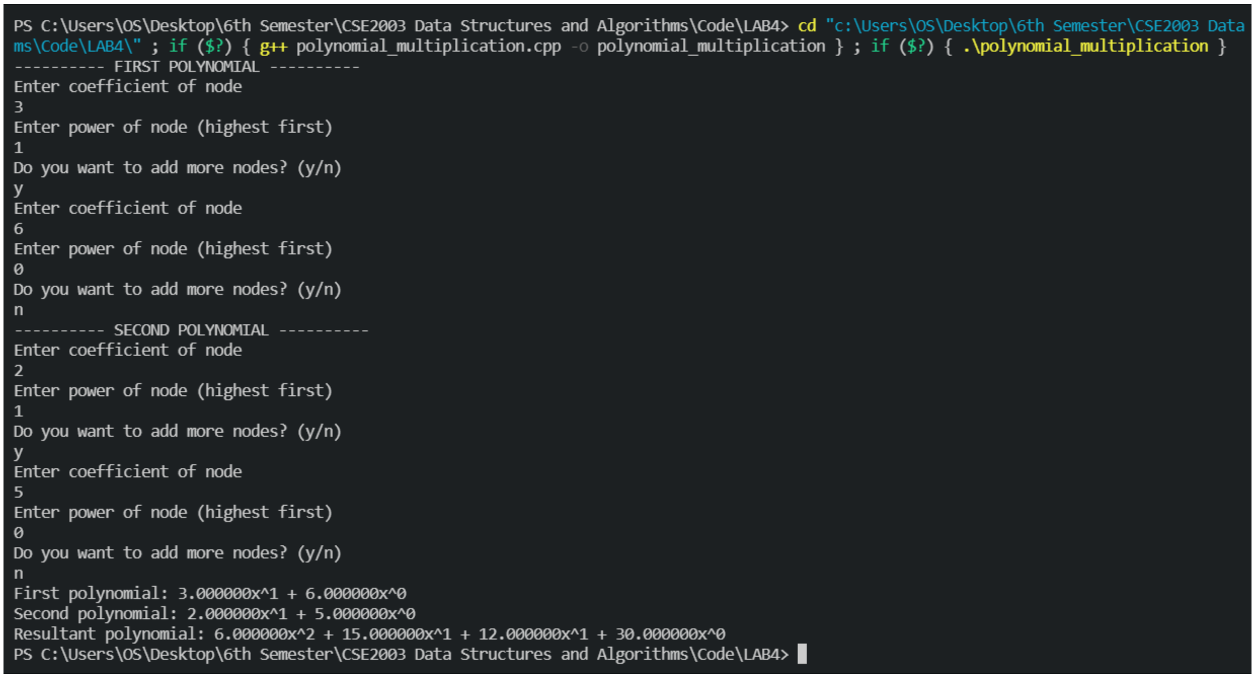


```
        temp->power = power;
        temp->coeff = coeff;
        head = temp;
        return head;
    }
    struct Node *initial = head;
    while (head->next != NULL)
    {
        head = head->next;
    }
    temp->coeff = coeff;
    temp->power = power;
    temp->next = NULL;
    head->next = temp;
    head = initial;
    return head;
}
struct Node *MulPoly(struct Node *f1, struct Node *f2)
{
    int l1 = GetLength(f1);
    int l2 = GetLength(f2);
    struct Node *initialf2 = f2;
    struct Node *result = new Node;
    result = NULL;
    while (f1 != NULL)
    {
        while (f2 != NULL)
        {
            float resultCoeff = f1->coeff * f2->coeff;
            result = Create(result, resultCoeff, f1->power + f2->power);
            f2 = f2->next;
        }
        f2 = initialf2;
        f1 = f1->next;
    }
    return result;
}
int main()
{

    struct Node *head1 = new Node;
    struct Node *head2 = new Node;
    head1 = NULL;
    head2 = NULL;
    cout << "---------- FIRST POLYNOMIAL ----------" << endl;
```



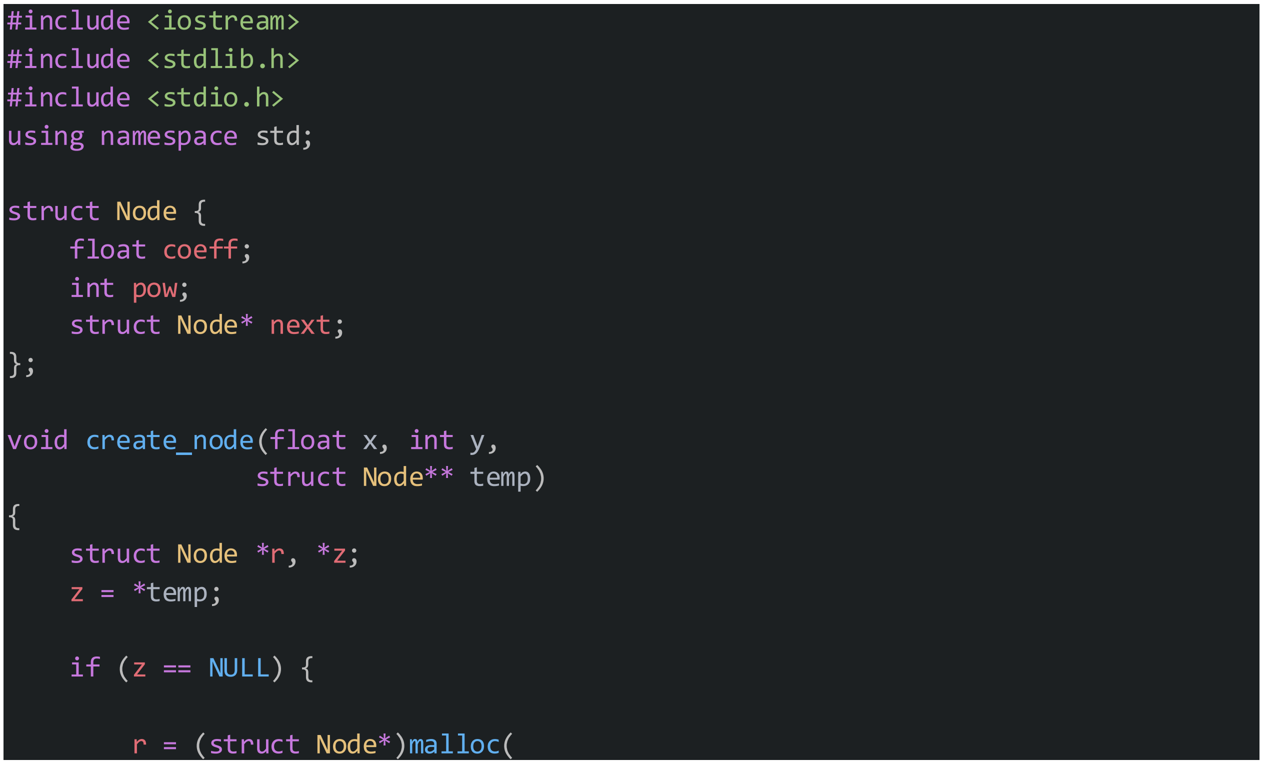
```
    char c1;
    do
    {
        float coeff;
        int power;
        cout << "Enter coefficient of node" << endl;
        cin >> coeff;
        cout << "Enter power of node (highest first)" << endl;
        cin >> power;
        head1 = Create(head1, coeff, power);
        cout << "Do you want to add more nodes? (y/n)" << endl;
        cin >> c1;
    } while (c1 != 'n');

    cout << "---------- SECOND POLYNOMIAL ----------" << endl;
    char c2;
    do
    {
        float coeff;
        int power;
        cout << "Enter coefficient of node" << endl;
        cin >> coeff;
        cout << "Enter power of node (highest first)" << endl;
        cin >> power;
        head2 = Create(head2, coeff, power);
        cout << "Do you want to add more nodes? (y/n)" << endl;
        cin >> c2;
    } while (c2 != 'n');

    struct Node *result = new Node;
    result = NULL;
    result = MulPoly(head1, head2);

    cout << "First polynomial: " << Display(head1) << endl;
    cout << "Second polynomial: " << Display(head2) << endl;
    cout << "Resultant polynomial: " << Display(result) << endl;
}
```

Output for multiplication:

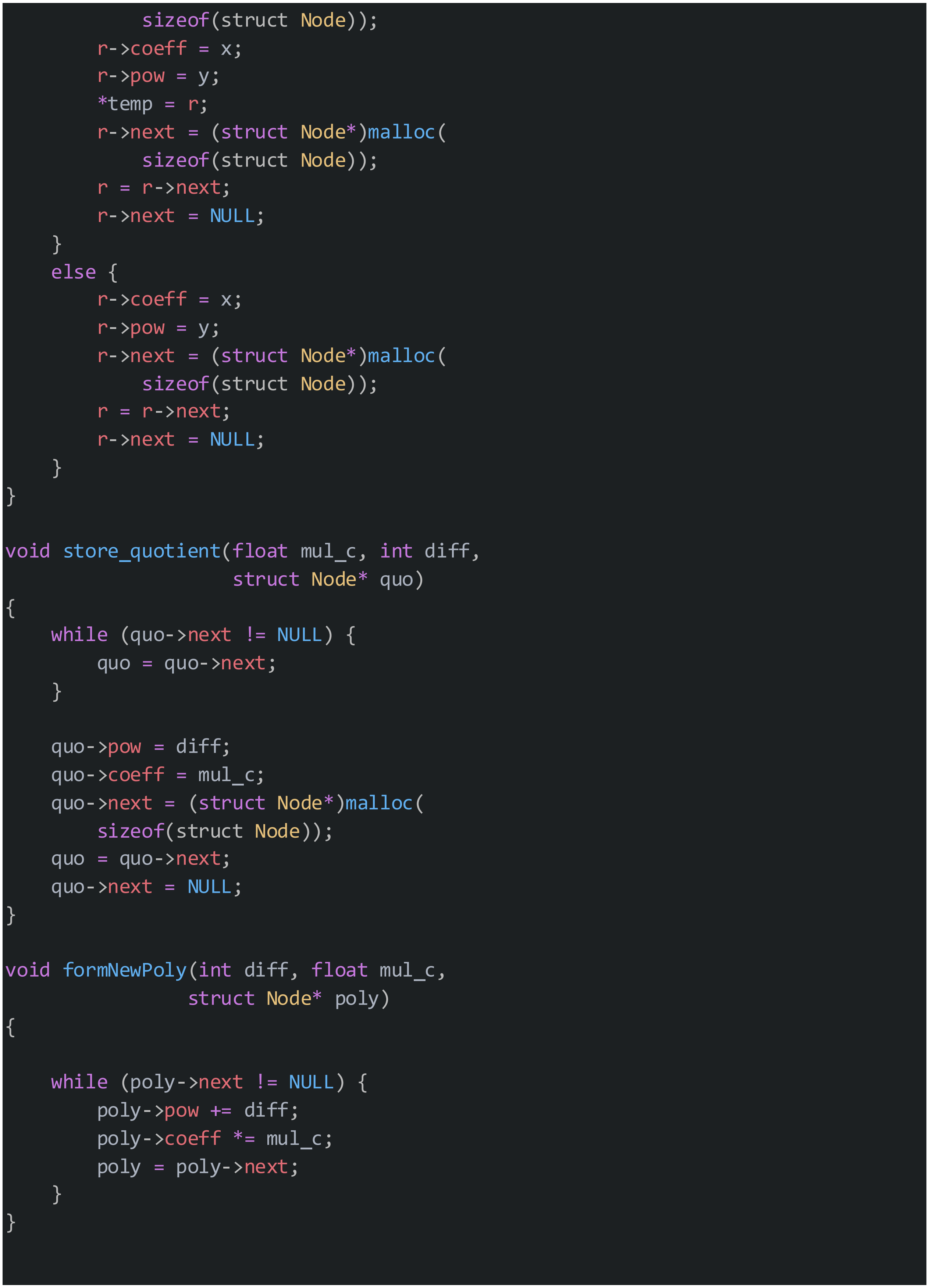


```
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> cd "c:\Users\OS\Desktop\6th Semester\CSE2003 Data
ms\Code\LAB4\" ; if ($?) { g++ polynomial_multiplication.cpp -o polynomial_multiplication } ; if ($?) { .\polynomial_multiplication }
---------- FIRST POLYNOMIAL ----------
Enter coefficient of node
3
Enter power of node (highest first)
1
Do you want to add more nodes? (y/n)
y
Enter coefficient of node
6
Enter power of node (highest first)
0
Do you want to add more nodes? (y/n)
n
---------- SECOND POLYNOMIAL ----------
Enter coefficient of node
2
Enter power of node (highest first)
1
Do you want to add more nodes? (y/n)
y
Enter coefficient of node
5
Enter power of node (highest first)
0
Do you want to add more nodes? (y/n)
n
First polynomial: 3.000000x^1 + 6.000000x^0
Second polynomial: 2.000000x^1 + 5.000000x^0
Resultant polynomial: 6.000000x^2 + 15.000000x^1 + 12.000000x^1 + 30.000000x^0
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> ▌
```

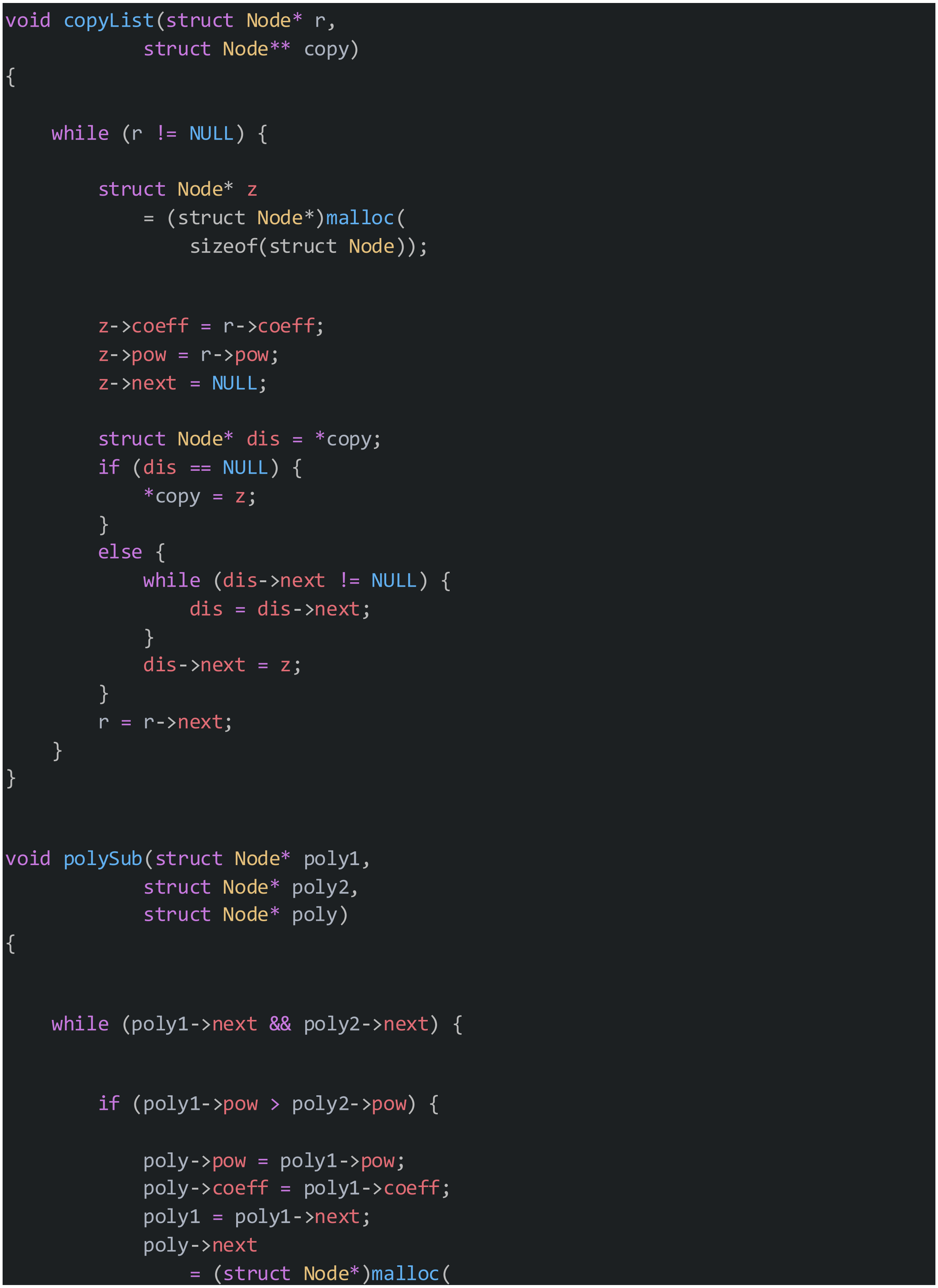
Code for division:



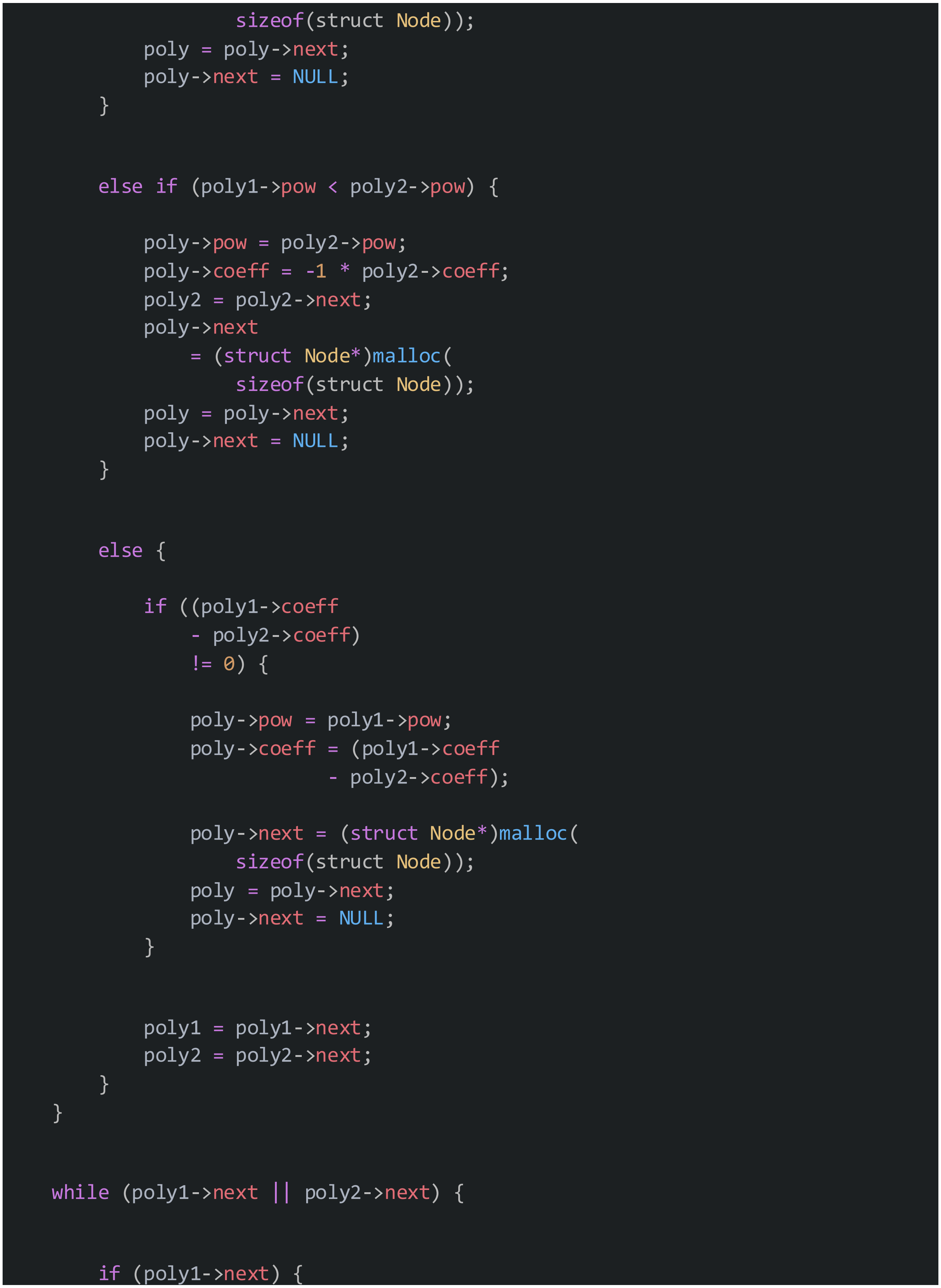
```cpp
#include <iostream>
#include <stdlib.h>
#include <stdio.h>
using namespace std;

struct Node {
    float coeff;
    int pow;
    struct Node* next;
};

void create_node(float x, int y,
                struct Node** temp)
{
    struct Node *r, *z;
    z = *temp;

    if (z == NULL) {

        r = (struct Node*)malloc(
```



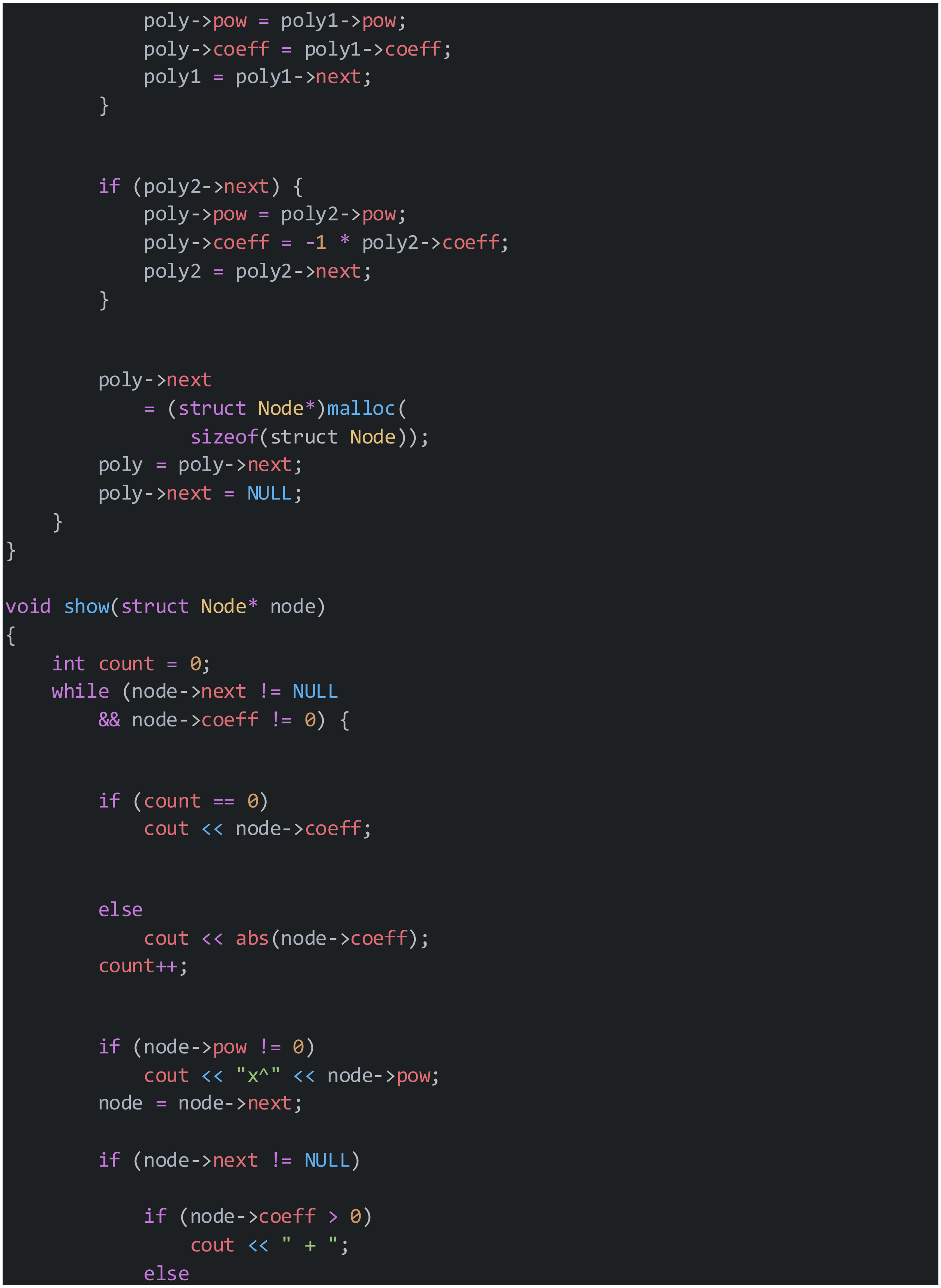
```
            sizeof(struct Node));
        r->coeff = x;
        r->pow = y;
        *temp = r;
        r->next = (struct Node*)malloc(
            sizeof(struct Node));
        r = r->next;
        r->next = NULL;
    }
    else {
        r->coeff = x;
        r->pow = y;
        r->next = (struct Node*)malloc(
            sizeof(struct Node));
        r = r->next;
        r->next = NULL;
    }
}

void store_quotient(float mul_c, int diff,
                    struct Node* quo)
{
    while (quo->next != NULL) {
        quo = quo->next;
    }

    quo->pow = diff;
    quo->coeff = mul_c;
    quo->next = (struct Node*)malloc(
        sizeof(struct Node));
    quo = quo->next;
    quo->next = NULL;
}

void formNewPoly(int diff, float mul_c,
                struct Node* poly)
{

    while (poly->next != NULL) {
        poly->pow += diff;
        poly->coeff *= mul_c;
        poly = poly->next;
    }
}
```



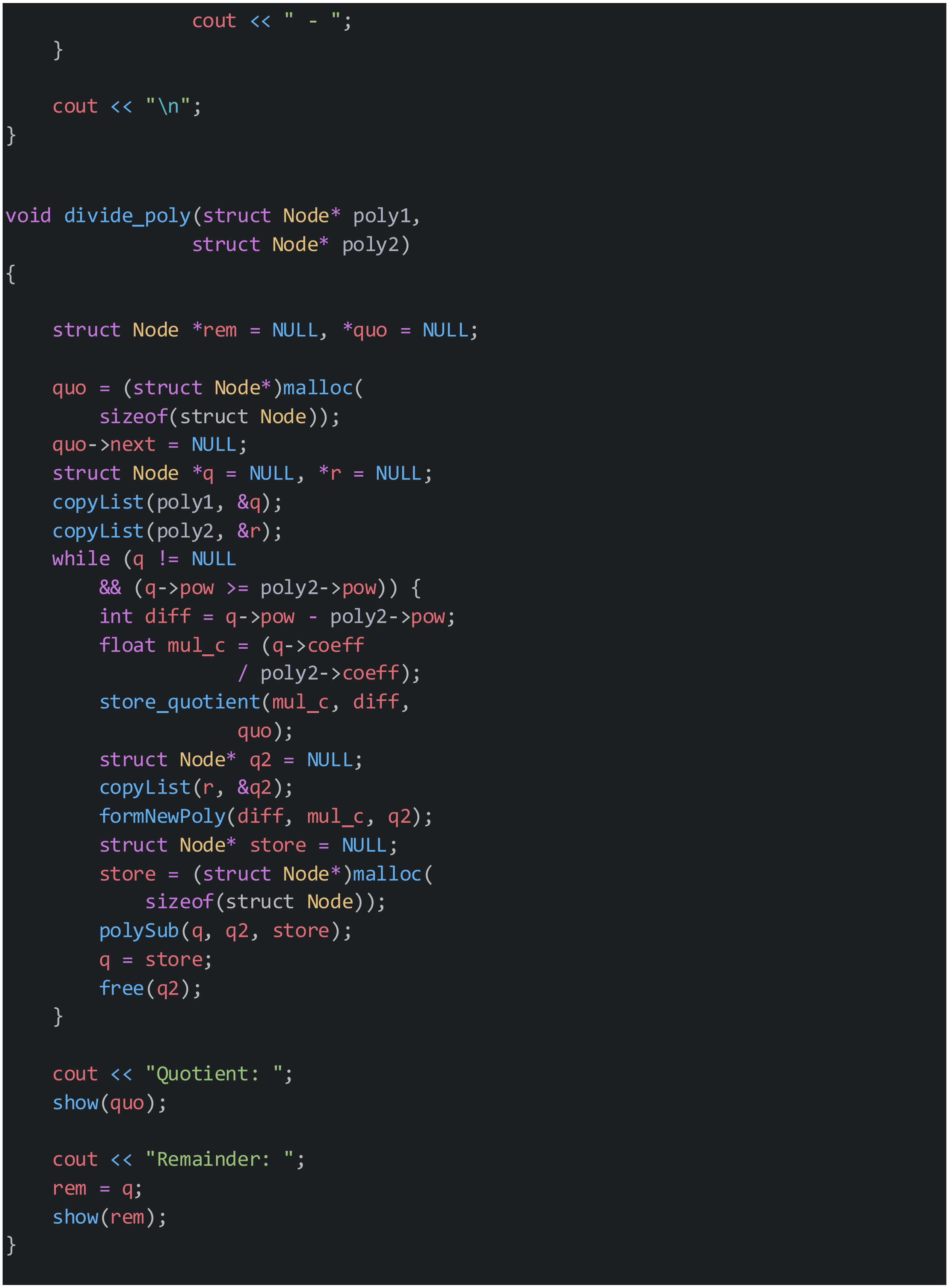
```
void copyList(struct Node* r,
            struct Node** copy)
{

    while (r != NULL) {

        struct Node* z
            = (struct Node*)malloc(
                sizeof(struct Node));


        z->coeff = r->coeff;
        z->pow = r->pow;
        z->next = NULL;

        struct Node* dis = *copy;
        if (dis == NULL) {
            *copy = z;
        }
        else {
            while (dis->next != NULL) {
                dis = dis->next;
            }
            dis->next = z;
        }
        r = r->next;
    }
}


void polySub(struct Node* poly1,
            struct Node* poly2,
            struct Node* poly)
{


    while (poly1->next && poly2->next) {


        if (poly1->pow > poly2->pow) {

            poly->pow = poly1->pow;
            poly->coeff = poly1->coeff;
            poly1 = poly1->next;
            poly->next
                = (struct Node*)malloc(
```



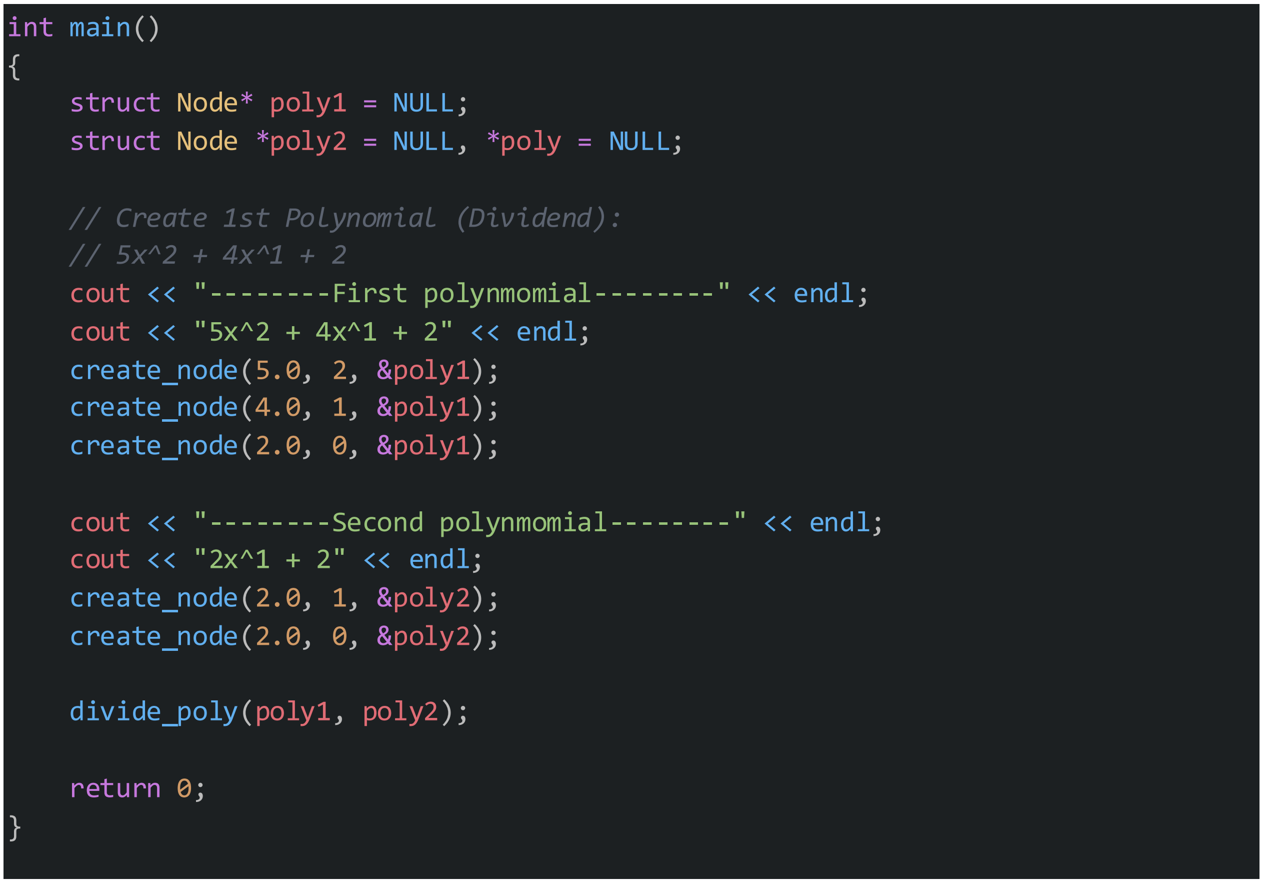
```
                sizeof(struct Node));
        poly = poly->next;
        poly->next = NULL;
    }


    else if (poly1->pow < poly2->pow) {

        poly->pow = poly2->pow;
        poly->coeff = -1 * poly2->coeff;
        poly2 = poly2->next;
        poly->next
            = (struct Node*)malloc(
                sizeof(struct Node));
        poly = poly->next;
        poly->next = NULL;
    }


    else {

        if ((poly1->coeff
            - poly2->coeff)
            != 0) {

            poly->pow = poly1->pow;
            poly->coeff = (poly1->coeff
                        - poly2->coeff);

            poly->next = (struct Node*)malloc(
                sizeof(struct Node));
            poly = poly->next;
            poly->next = NULL;
        }


        poly1 = poly1->next;
        poly2 = poly2->next;
    }
}


while (poly1->next || poly2->next) {


    if (poly1->next) {
```



```
            poly->pow = poly1->pow;
            poly->coeff = poly1->coeff;
            poly1 = poly1->next;
        }


        if (poly2->next) {
            poly->pow = poly2->pow;
            poly->coeff = -1 * poly2->coeff;
            poly2 = poly2->next;
        }


        poly->next
            = (struct Node*)malloc(
                sizeof(struct Node));
        poly = poly->next;
        poly->next = NULL;
    }
}

void show(struct Node* node)
{
    int count = 0;
    while (node->next != NULL
        && node->coeff != 0) {


        if (count == 0)
            cout << node->coeff;


        else
            cout << abs(node->coeff);
        count++;


        if (node->pow != 0)
            cout << "x^" << node->pow;
        node = node->next;

        if (node->next != NULL)

            if (node->coeff > 0)
                cout << " + ";
            else
```

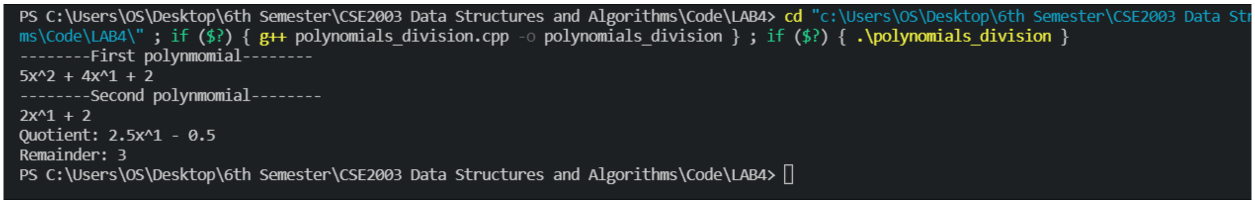


```
                cout << " - ";
    }

    cout << "\n";
}


void divide_poly(struct Node* poly1,
                struct Node* poly2)
{

    struct Node *rem = NULL, *quo = NULL;

    quo = (struct Node*)malloc(
        sizeof(struct Node));
    quo->next = NULL;
    struct Node *q = NULL, *r = NULL;
    copyList(poly1, &q);
    copyList(poly2, &r);
    while (q != NULL
        && (q->pow >= poly2->pow)) {
        int diff = q->pow - poly2->pow;
        float mul_c = (q->coeff
                    / poly2->coeff);
        store_quotient(mul_c, diff,
                    quo);
        struct Node* q2 = NULL;
        copyList(r, &q2);
        formNewPoly(diff, mul_c, q2);
        struct Node* store = NULL;
        store = (struct Node*)malloc(
            sizeof(struct Node));
        polySub(q, q2, store);
        q = store;
        free(q2);
    }

    cout << "Quotient: ";
    show(quo);

    cout << "Remainder: ";
    rem = q;
    show(rem);
}
```



```cpp
int main()
{
    struct Node* poly1 = NULL;
    struct Node *poly2 = NULL, *poly = NULL;

    // Create 1st Polynomial (Dividend):
    // 5x^2 + 4x^1 + 2
    cout << "--------First polynmomial--------" << endl;
    cout << "5x^2 + 4x^1 + 2" << endl;
    create_node(5.0, 2, &poly1);
    create_node(4.0, 1, &poly1);
    create_node(2.0, 0, &poly1);

    cout << "--------Second polynmomial--------" << endl;
    cout << "2x^1 + 2" << endl;
    create_node(2.0, 1, &poly2);
    create_node(2.0, 0, &poly2);

    divide_poly(poly1, poly2);

    return 0;
}
```

Output for division:



```
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> cd "c:\Users\OS\Desktop\6th Semester\CSE2003 Data Str
ms\Code\LAB4\" ; if ($?) { g++ polynomials_division.cpp -o polynomials_division } ; if ($?) { .\polynomials_division }
--------First polynmomial--------
5x^2 + 4x^1 + 2
--------Second polynmomial--------
2x^1 + 2
Quotient: 2.5x^1 - 0.5
Remainder: 3
PS C:\Users\OS\Desktop\6th Semester\CSE2003 Data Structures and Algorithms\Code\LAB4> 
```

Conclusion

Thus, we have implemented linear and circular doubly linked lists, and also seen how they can be used for simple applications such as polynomial addition, subtraction, multiplication and division.

Neh Samir Joshi

19BEC1112