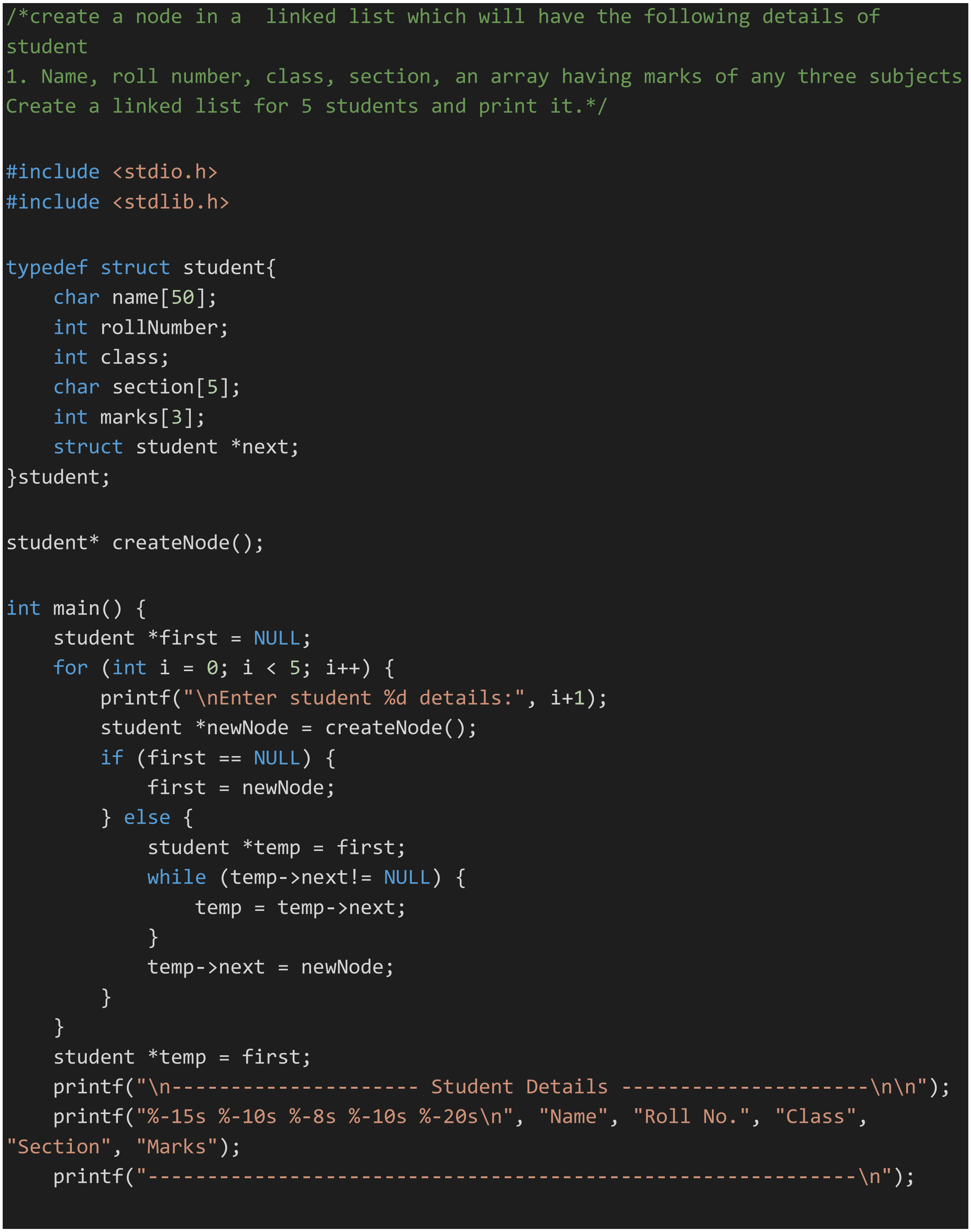
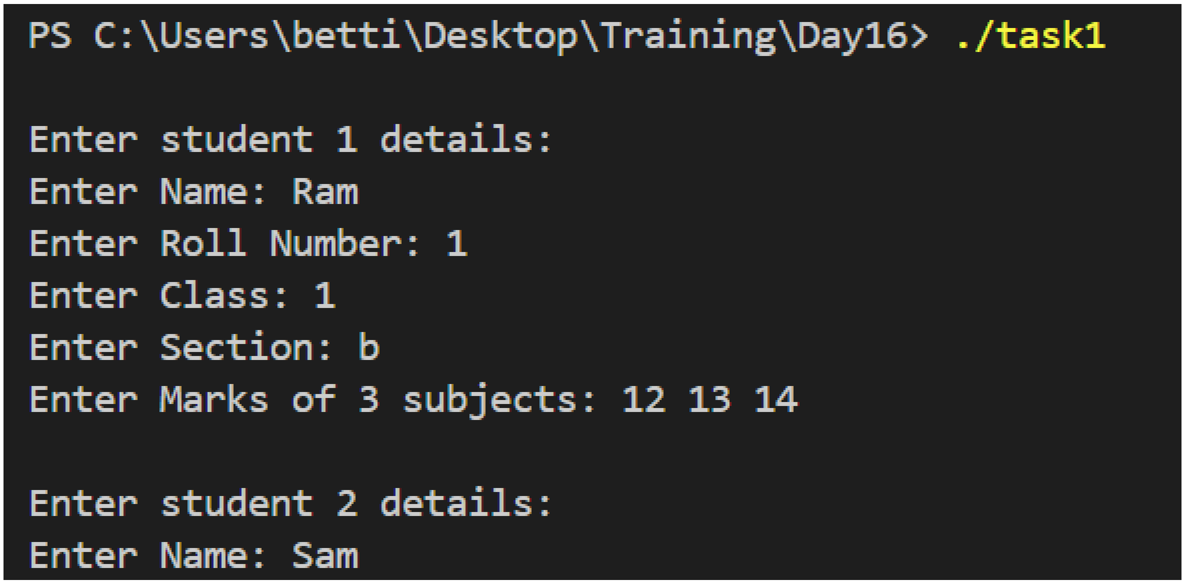
1.

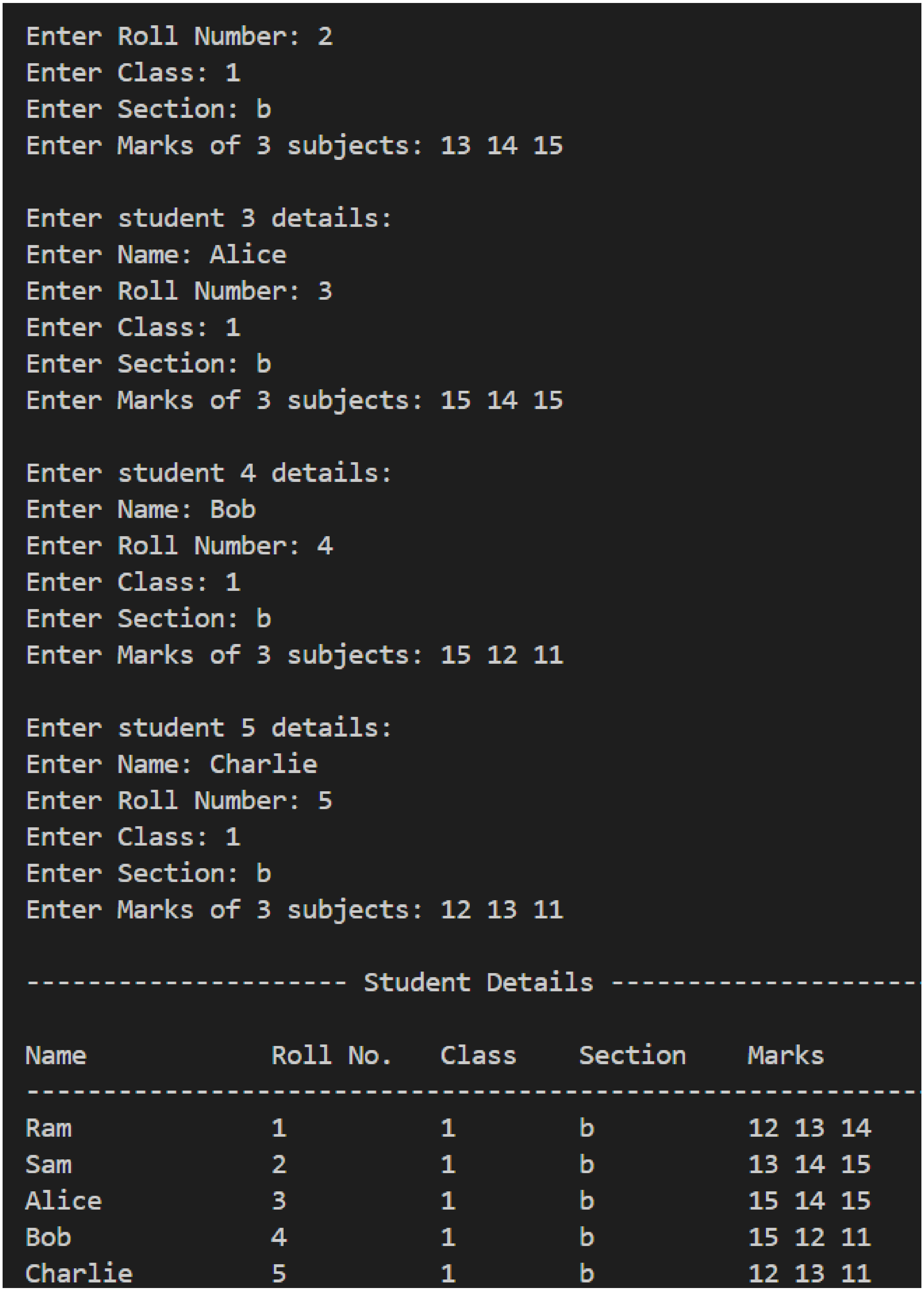


```c
/*create a node in a  linked list which will have the following details of
student
1. Name, roll number, class, section, an array having marks of any three subjects
Create a linked list for 5 students and print it.*/

#include <stdio.h>
#include <stdlib.h>

typedef struct student{
    char name[50];
    int rollNumber;
    int class;
    char section[5];
    int marks[3];
    struct student *next;
}student;

student* createNode();

int main() {
    student *first = NULL;
    for (int i = 0; i < 5; i++) {
        printf("\nEnter student %d details:", i+1);
        student *newNode = createNode();
        if (first == NULL) {
            first = newNode;
        } else {
            student *temp = first;
            while (temp->next!= NULL) {
                temp = temp->next;
            }
            temp->next = newNode;
        }
    }
    student *temp = first;
    printf("\n---------------------- Student Details ---------------------\n\n");
    printf("%-15s %-10s %-8s %-10s %-20s\n", "Name", "Roll No.", "Class",
"Section", "Marks");
    printf("------------------------------------------------------------\n");
```

```c
    while (temp != NULL) {
    printf("%-15s %-10d %-8d %-10s ", temp->name, temp->rollNumber, temp->class,
temp->section);
    for (int i = 0; i < 3; i++) {
        printf("%d ", temp->marks[i]);
    }
    printf("\n");
    temp = temp->next;
}



    while (first!= NULL) {
        student *temp = first;
        first = first->next;
        free(temp);
    }
    return 0;
}

student* createNode() {
    student *newNode = (student*)malloc(sizeof(student));
    if (!newNode) {
        printf("Memory allocation failed!\n");
        exit(1);
    }

    printf("\nEnter Name: ");
    scanf("%s", newNode->name);
    printf("Enter Roll Number: ");
    scanf("%d", &newNode->rollNumber);
    printf("Enter Class: ");
    scanf("%d", &newNode->class);
    printf("Enter Section: ");
    scanf("%s", newNode->section);
    printf("Enter Marks of 3 subjects: ");
    for (int i = 0; i < 3; i++) {
        scanf("%d", &newNode->marks[i]);
    }
    newNode->next = NULL;
    return newNode;
}
```



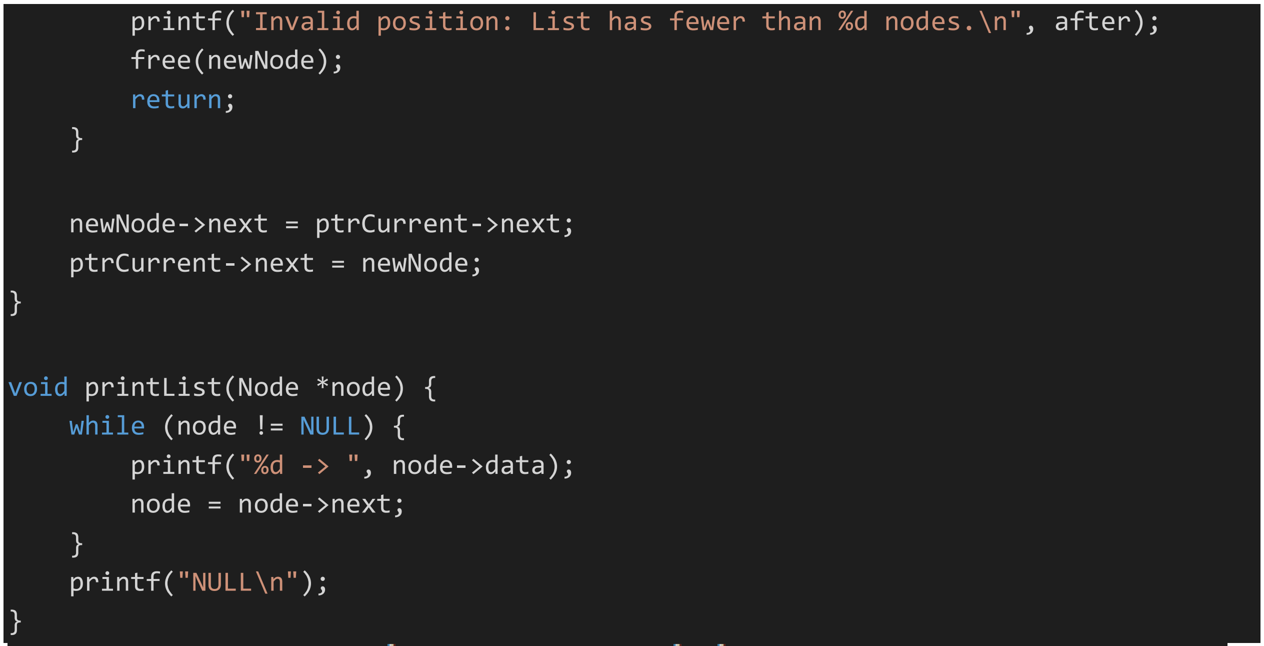
```
PS C:\Users\betti\Desktop\Training\Day16> ./task1

Enter student 1 details:
Enter Name: Ram
Enter Roll Number: 1
Enter Class: 1
Enter Section: b
Enter Marks of 3 subjects: 12 13 14

Enter student 2 details:
Enter Name: Sam
```



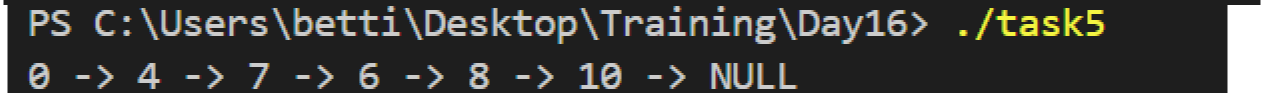
```
Enter Roll Number: 2
Enter Class: 1
Enter Section: b
Enter Marks of 3 subjects: 13 14 15

Enter student 3 details:
Enter Name: Alice
Enter Roll Number: 3
Enter Class: 1
Enter Section: b
Enter Marks of 3 subjects: 15 14 15

Enter student 4 details:
Enter Name: Bob
Enter Roll Number: 4
Enter Class: 1
Enter Section: b
Enter Marks of 3 subjects: 15 12 11

Enter student 5 details:
Enter Name: Charlie
Enter Roll Number: 5
Enter Class: 1
Enter Section: b
Enter Marks of 3 subjects: 12 13 11

--------------------- Student Details --------------------

Name            Roll No.   Class    Section    Marks
----------------------------------------------------------
Ram             1          1        b          12 13 14
Sam             2          1        b          13 14 15
Alice           3          1        b          15 14 15
Bob             4          1        b          15 12 11
Charlie         5          1        b          12 13 11
```

2.

```
/*Implementation of adding nodes to a linked list*/
#include <stdio.h>
#include <stdlib.h>

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

void InsertFront(Node **, int);
void InsertMiddle(Node *, int, int);
void InsertEnd(Node **, int);
void printList(Node *);

int main() {
    Node *head = NULL;

    InsertEnd(&head, 6);
    InsertEnd(&head, 8);
    InsertEnd(&head, 10);
    InsertFront(&head, 4);
    InsertFront(&head, 0);
    InsertMiddle(head, 2, 7);  // Inserts 7 after position 2 (1-based indexing)

    printList(head);
    return 0;
}

void InsertEnd(Node **ptrHead, int nData) {
    Node *newNode = (Node *)malloc(sizeof(Node));
    if (newNode == NULL) {
        printf("Memory allocation failed.\n");
        return;
    }
    newNode->data = nData;
    newNode->next = NULL;

    if (*ptrHead == NULL) {
        *ptrHead = newNode;
    } else {
        Node *ptrTail = *ptrHead;
        while (ptrTail->next != NULL) {
            ptrTail = ptrTail->next;
        }
        ptrTail->next = newNode;
    }
}

void InsertFront(Node **ptrHead, int nData) {
    Node *newNode = (Node *)malloc(sizeof(Node));
    if (newNode == NULL) {
        printf("Memory allocation failed.\n");
        return;
    }
    newNode->data = nData;
    newNode->next = *ptrHead;
    *ptrHead = newNode;
}

void InsertMiddle(Node *ptrHead, int after, int nData) {
    if (ptrHead == NULL) {
        printf("The list is empty. Cannot insert at position %d.\n", after);
        return;
    }

    Node *newNode = (Node *)malloc(sizeof(Node));
    if (newNode == NULL) {
        printf("Memory allocation failed.\n");
        return;
    }
    newNode->data = nData;
    newNode->next = NULL;

    Node *ptrCurrent = ptrHead;
    int count = 1;

    while (ptrCurrent != NULL && count < after) {
        ptrCurrent = ptrCurrent->next;
        count++;
    }

    if (ptrCurrent == NULL) {
```

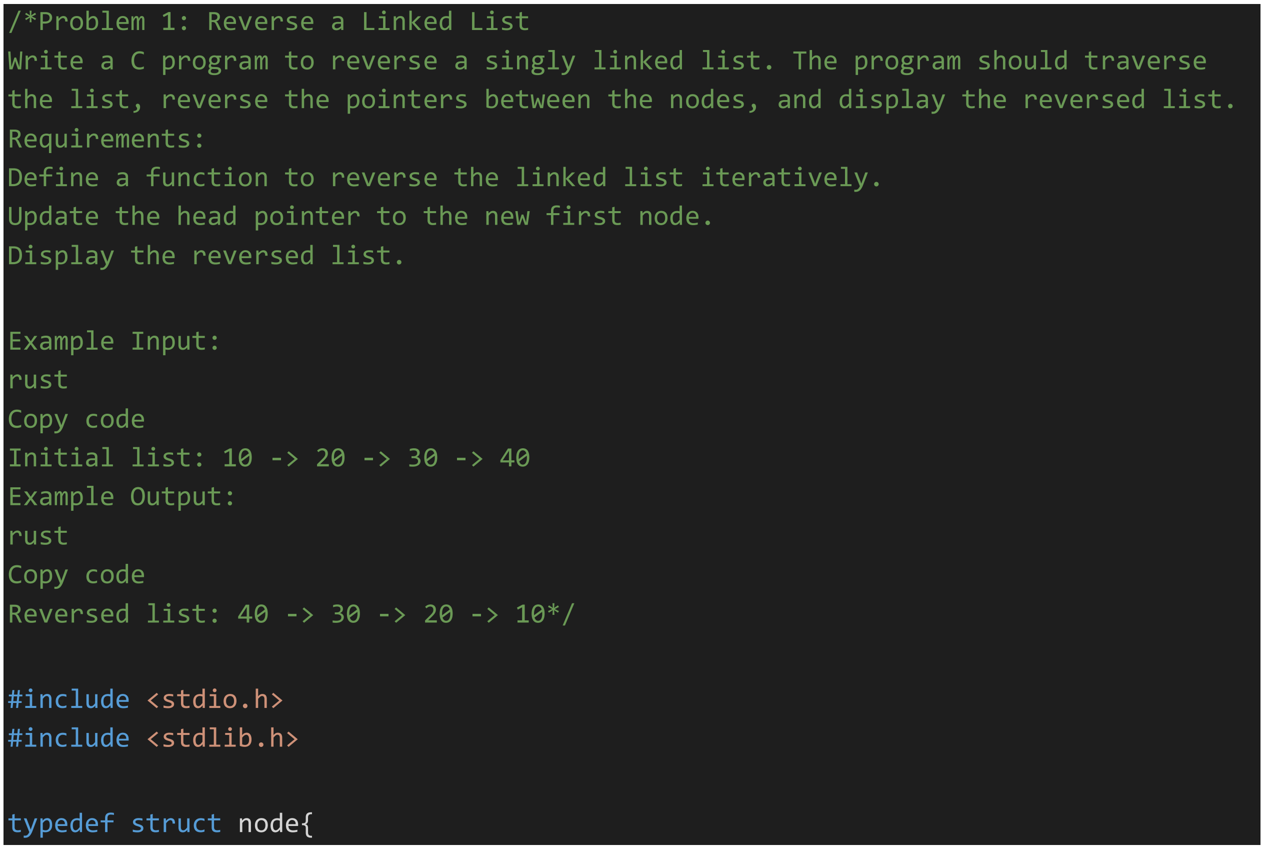


```
        printf("Invalid position: List has fewer than %d nodes.\n", after);
        free(newNode);
        return;
    }

    newNode->next = ptrCurrent->next;
    ptrCurrent->next = newNode;
}

void printList(Node *node) {
    while (node != NULL) {
        printf("%d -> ", node->data);
        node = node->next;
    }
    printf("NULL\n");
}
```

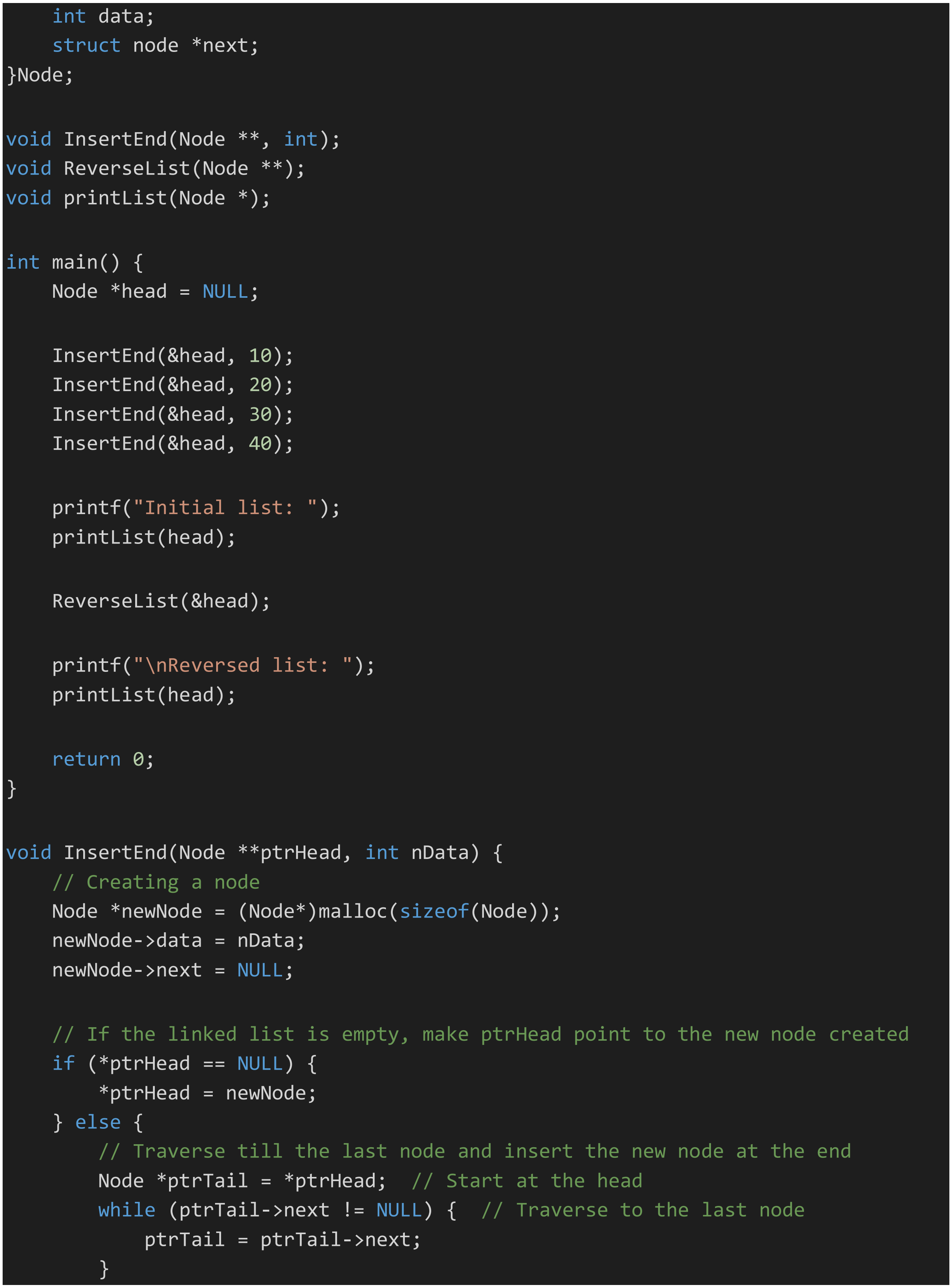


```
PS C:\Users\betti\Desktop\Training\Day16> ./task5
0 -> 4 -> 7 -> 6 -> 8 -> 10 -> NULL
```

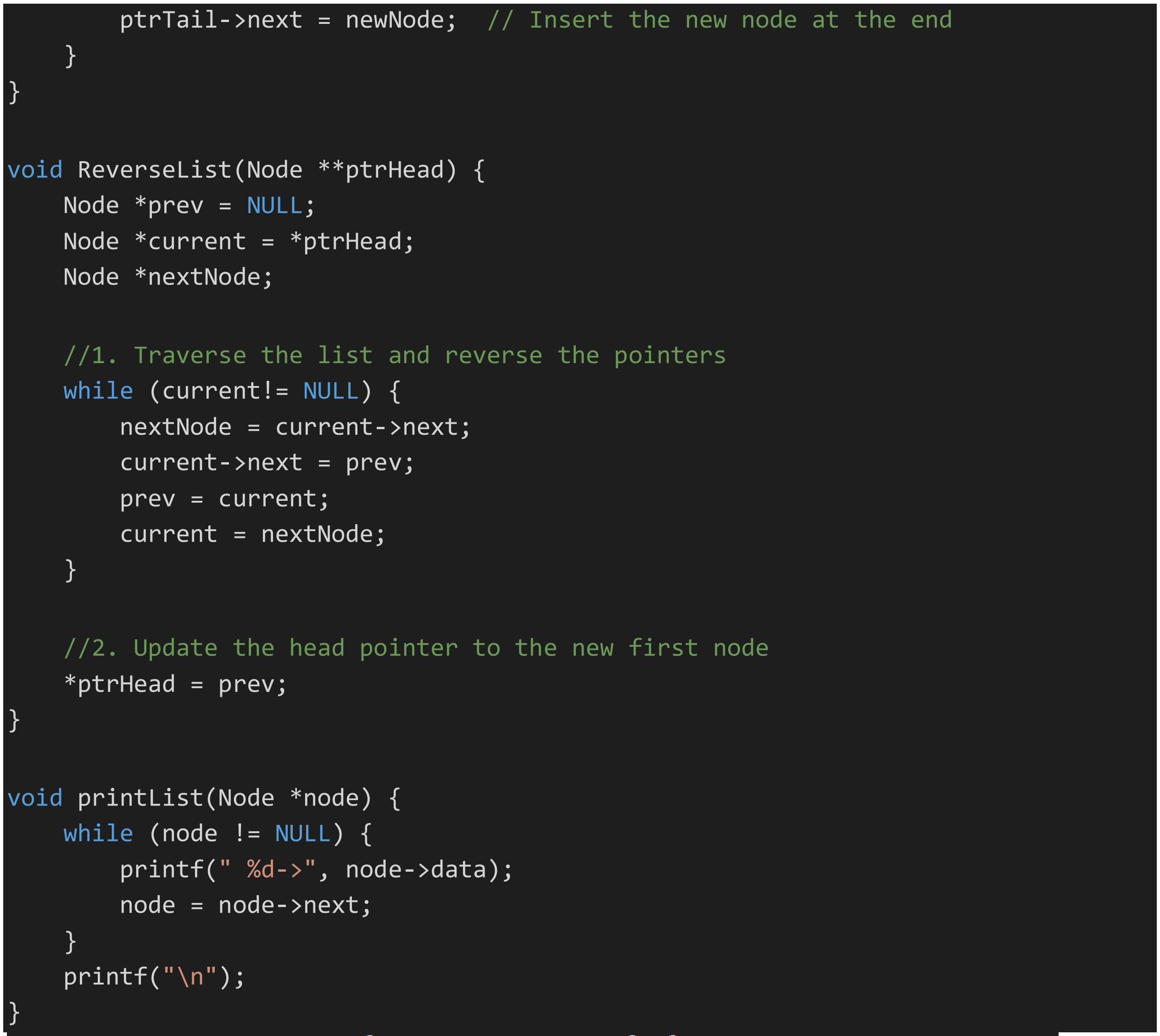
3.



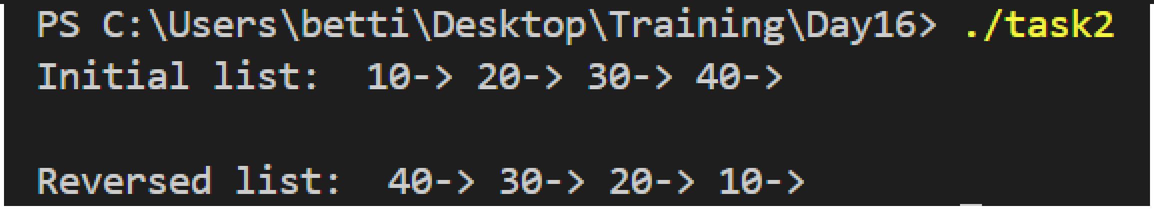
```
/*Problem 1: Reverse a Linked List
Write a C program to reverse a singly linked list. The program should traverse
the list, reverse the pointers between the nodes, and display the reversed list.
Requirements:
Define a function to reverse the linked list iteratively.
Update the head pointer to the new first node.
Display the reversed list.

Example Input:
rust
Copy code
Initial list: 10 -> 20 -> 30 -> 40
Example Output:
rust
Copy code
Reversed list: 40 -> 30 -> 20 -> 10*/

#include <stdio.h>
#include <stdlib.h>

typedef struct node{
```



```
    int data;
    struct node *next;
}Node;

void InsertEnd(Node **, int);
void ReverseList(Node **);
void printList(Node *);

int main() {
    Node *head = NULL;

    InsertEnd(&head, 10);
    InsertEnd(&head, 20);
    InsertEnd(&head, 30);
    InsertEnd(&head, 40);

    printf("Initial list: ");
    printList(head);

    ReverseList(&head);

    printf("\nReversed list: ");
    printList(head);

    return 0;
}

void InsertEnd(Node **ptrHead, int nData) {
    // Creating a node
    Node *newNode = (Node*)malloc(sizeof(Node));
    newNode->data = nData;
    newNode->next = NULL;

    // If the linked list is empty, make ptrHead point to the new node created
    if (*ptrHead == NULL) {
        *ptrHead = newNode;
    } else {
        // Traverse till the last node and insert the new node at the end
        Node *ptrTail = *ptrHead;  // Start at the head
        while (ptrTail->next != NULL) {  // Traverse to the last node
            ptrTail = ptrTail->next;
        }
```

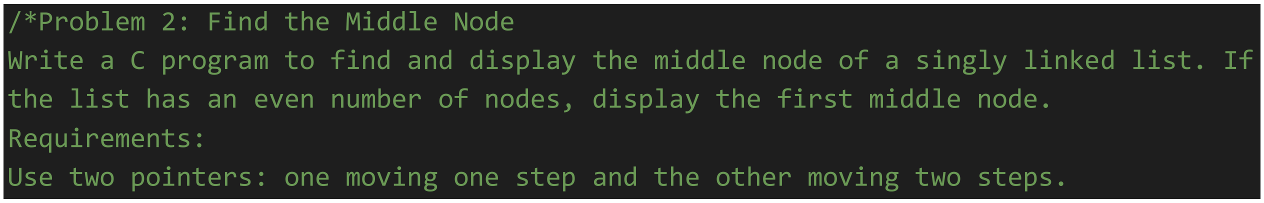


```c
        ptrTail->next = newNode;  // Insert the new node at the end
    }
}

void ReverseList(Node **ptrHead) {
    Node *prev = NULL;
    Node *current = *ptrHead;
    Node *nextNode;

    //1. Traverse the list and reverse the pointers
    while (current!= NULL) {
        nextNode = current->next;
        current->next = prev;
        prev = current;
        current = nextNode;
    }

    //2. Update the head pointer to the new first node
    *ptrHead = prev;
}

void printList(Node *node) {
    while (node != NULL) {
        printf(" %d->", node->data);
        node = node->next;
    }
    printf("\n");
}
```



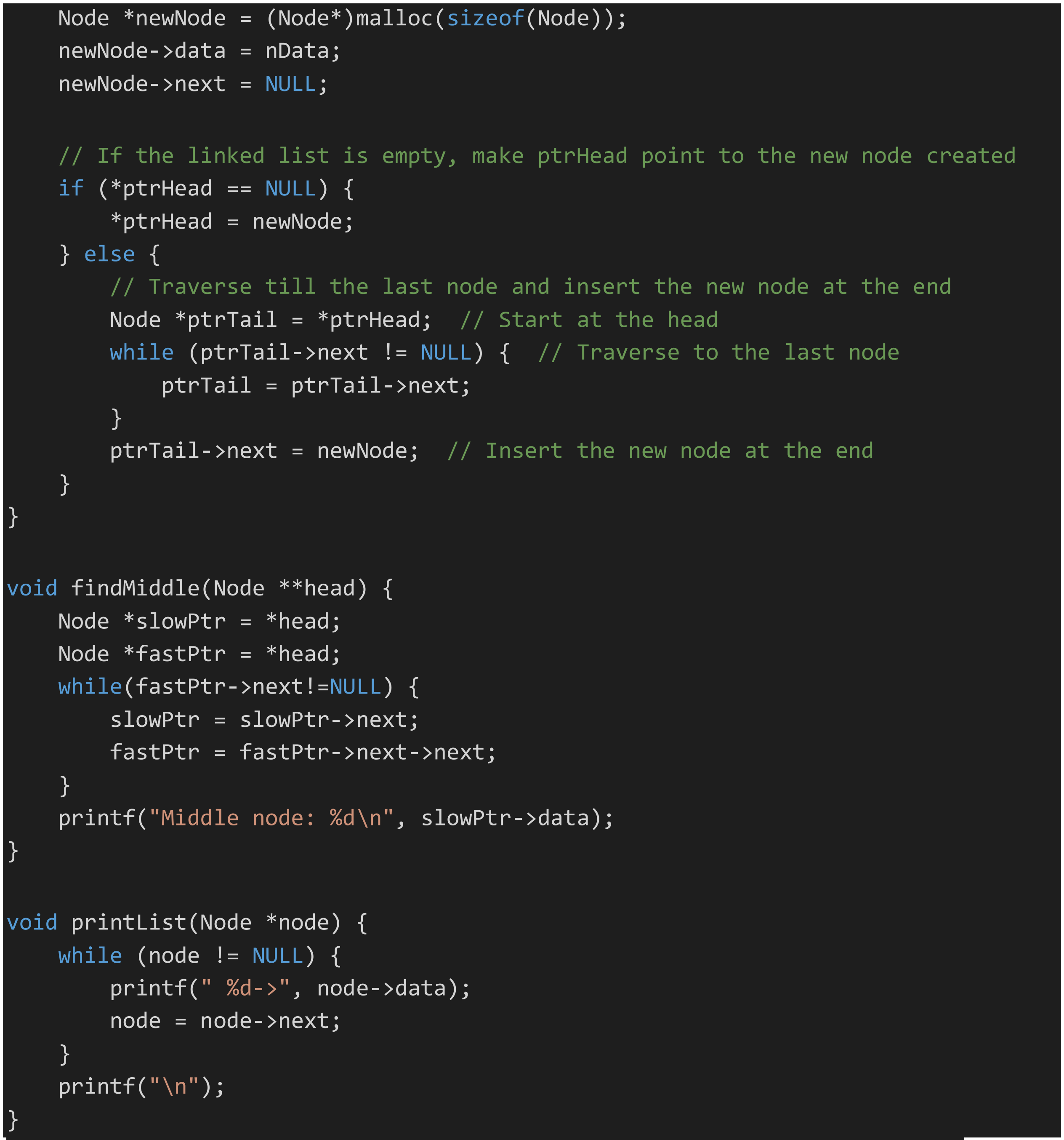
```
PS C:\Users\betti\Desktop\Training\Day16> ./task2
Initial list:  10-> 20-> 30-> 40->

Reversed list:  40-> 30-> 20-> 10->
```

4.

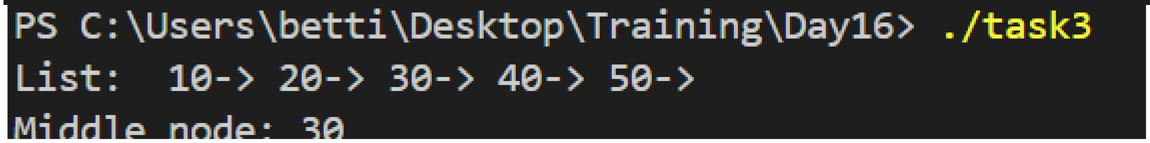


```
/*Problem 2: Find the Middle Node
Write a C program to find and display the middle node of a singly linked list. If
the list has an even number of nodes, display the first middle node.
Requirements:
Use two pointers: one moving one step and the other moving two steps.
```

```
When the faster pointer reaches the end, the slower pointer will point to the
middle node.
Example Input:
rust
Copy code
List: 10 -> 20 -> 30 -> 40 -> 50
Example Output:
scss
Copy code
Middle node: 30*/

#include <stdio.h>
#include <stdlib.h>

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

void InsertEnd(Node **, int);
void findMiddle(Node **);
void printList(Node *);

int main() {
    Node *head = NULL;

    InsertEnd(&head, 10);
    InsertEnd(&head, 20);
    InsertEnd(&head, 30);
    InsertEnd(&head, 40);
    InsertEnd(&head, 50);

    printf("List: ");
    printList(head);

    findMiddle(&head);

    return 0;
}

void InsertEnd(Node **ptrHead, int nData) {
    // Creating a node
```

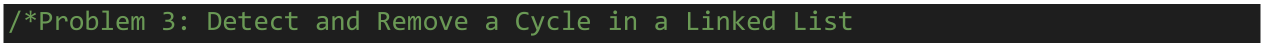


```
    Node *newNode = (Node*)malloc(sizeof(Node));
    newNode->data = nData;
    newNode->next = NULL;

    // If the linked list is empty, make ptrHead point to the new node created
    if (*ptrHead == NULL) {
        *ptrHead = newNode;
    } else {
        // Traverse till the last node and insert the new node at the end
        Node *ptrTail = *ptrHead;  // Start at the head
        while (ptrTail->next != NULL) {  // Traverse to the last node
            ptrTail = ptrTail->next;
        }
        ptrTail->next = newNode;  // Insert the new node at the end
    }
}

void findMiddle(Node **head) {
    Node *slowPtr = *head;
    Node *fastPtr = *head;
    while(fastPtr->next!=NULL) {
        slowPtr = slowPtr->next;
        fastPtr = fastPtr->next->next;
    }
    printf("Middle node: %d\n", slowPtr->data);
}

void printList(Node *node) {
    while (node != NULL) {
        printf(" %d->", node->data);
        node = node->next;
    }
    printf("\n");
}
```



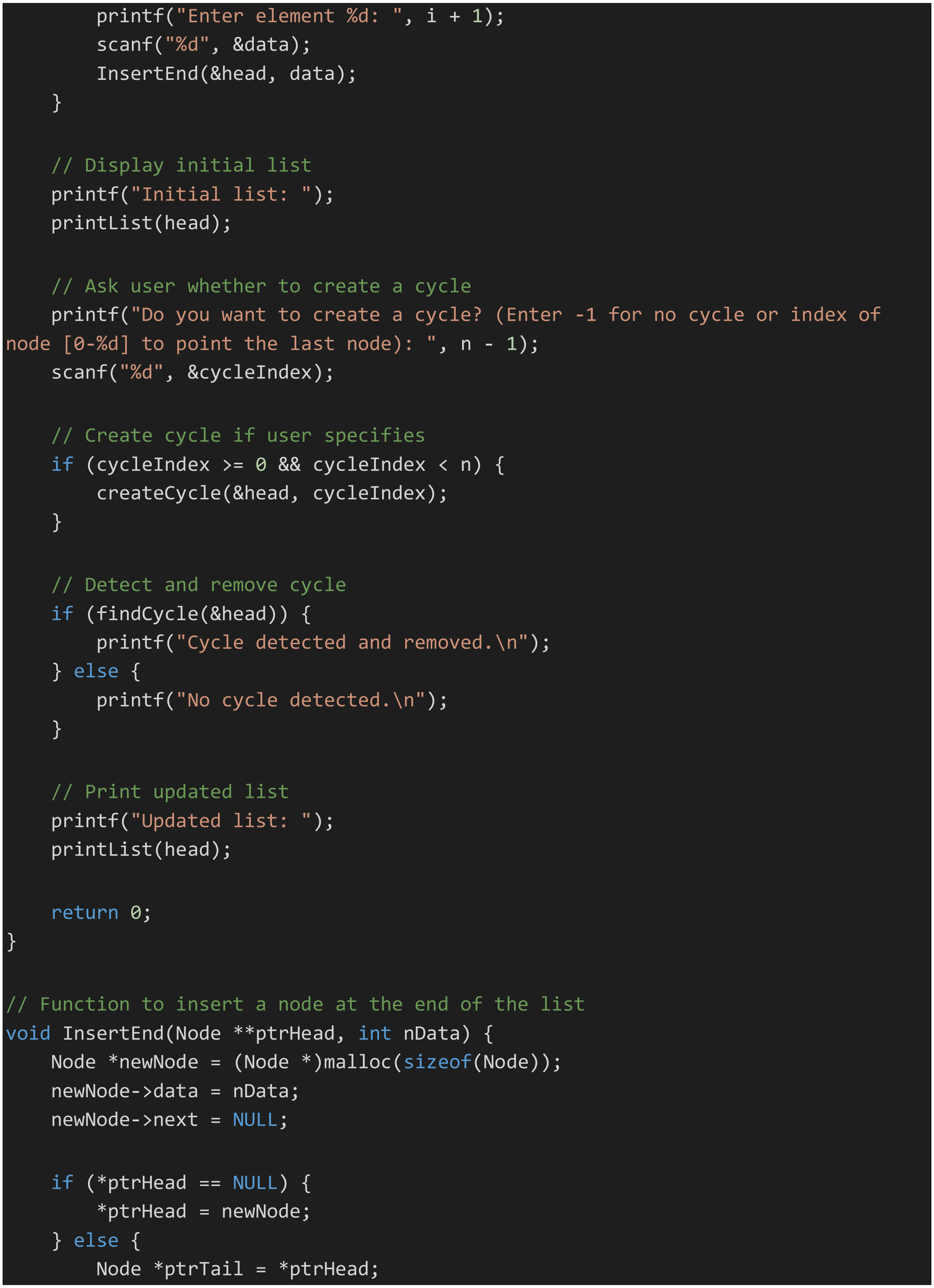
```
PS C:\Users\betti\Desktop\Training\Day16> ./task3
List:  10-> 20-> 30-> 40-> 50->
Middle node: 30
```

5.

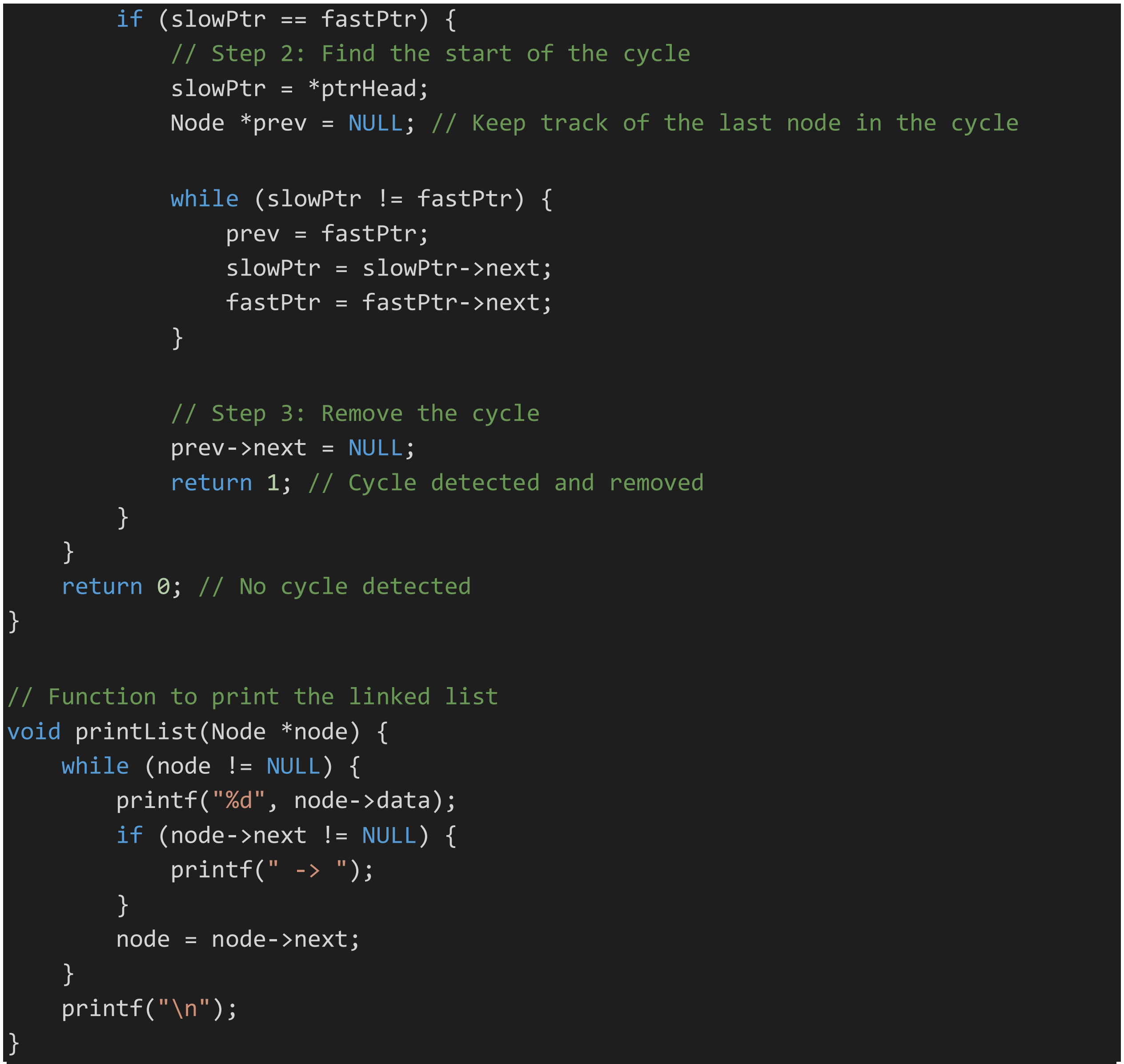


```
/*Problem 3: Detect and Remove a Cycle in a Linked List
```

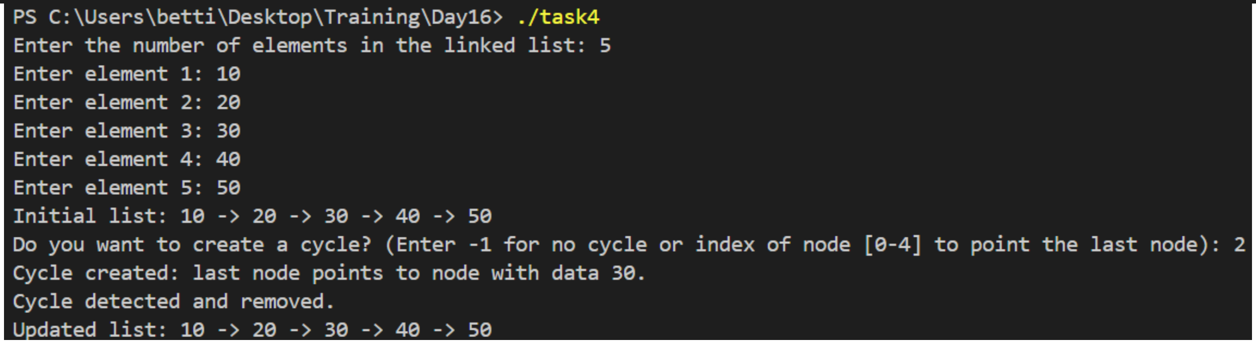
```
Write a C program to detect if a cycle (loop) exists in a singly linked list and
remove it if present. Use Floyd’s Cycle Detection Algorithm (slow and fast
pointers) to detect the cycle.
Requirements:
Detect the cycle in the list.
If a cycle exists, find the starting node of the cycle and break the loop.
Display the updated list.
Example Input:
rust
Copy code
List: 10 -> 20 -> 30 -> 40 -> 50 -> (points back to 30)
Example Output:
rust
Copy code
Cycle detected and removed.
Updated list: 10 -> 20 -> 30 -> 40 -> 50*/

#include <stdio.h>
#include <stdlib.h>

// Node structure
typedef struct node {
    int data;
    struct node *next;
} Node;

// Function Prototypes
void InsertEnd(Node **, int);
int findCycle(Node **);
void createCycle(Node **, int);
void printList(Node *);

// Main Function
int main() {
    Node *head = NULL;
    int n, data, cycleIndex;

    // Input number of nodes
    printf("Enter the number of elements in the linked list: ");
    scanf("%d", &n);

    // Input elements
    for (int i = 0; i < n; i++) {
```



```c
        printf("Enter element %d: ", i + 1);
        scanf("%d", &data);
        InsertEnd(&head, data);
    }

    // Display initial list
    printf("Initial list: ");
    printList(head);

    // Ask user whether to create a cycle
    printf("Do you want to create a cycle? (Enter -1 for no cycle or index of
node [0-%d] to point the last node): ", n - 1);
    scanf("%d", &cycleIndex);

    // Create cycle if user specifies
    if (cycleIndex >= 0 && cycleIndex < n) {
        createCycle(&head, cycleIndex);
    }

    // Detect and remove cycle
    if (findCycle(&head)) {
        printf("Cycle detected and removed.\n");
    } else {
        printf("No cycle detected.\n");
    }

    // Print updated list
    printf("Updated list: ");
    printList(head);

    return 0;
}

// Function to insert a node at the end of the list
void InsertEnd(Node **ptrHead, int nData) {
    Node *newNode = (Node *)malloc(sizeof(Node));
    newNode->data = nData;
    newNode->next = NULL;

    if (*ptrHead == NULL) {
        *ptrHead = newNode;
    } else {
        Node *ptrTail = *ptrHead;
        while (ptrTail->next != NULL) {
            ptrTail = ptrTail->next;
        }
        ptrTail->next = newNode;
    }
}

// Function to create a cycle at the specified index
void createCycle(Node **ptrHead, int index) {
    Node *cycleNode = NULL, *tail = *ptrHead;
    int count = 0;

    // Traverse the list to find the node at the given index
    while (tail->next != NULL) {
        if (count == index) {
            cycleNode = tail;
        }
        tail = tail->next;
        count++;
    }

    // Create the cycle
    if (cycleNode != NULL) {
        tail->next = cycleNode;
        printf("Cycle created: last node points to node with data %d.\n",
cycleNode->data);
    }
}

// Function to detect and remove a cycle in the linked list
int findCycle(Node **ptrHead) {
    if (*ptrHead == NULL || (*ptrHead)->next == NULL) {
        return 0; // No cycle possible in empty or single-node list
    }

    Node *slowPtr = *ptrHead;
    Node *fastPtr = *ptrHead;

    // Step 1: Detect the cycle using Floyd's Algorithm
    while (fastPtr != NULL && fastPtr->next != NULL) {
        slowPtr = slowPtr->next;
        fastPtr = fastPtr->next->next;
```



```
        if (slowPtr == fastPtr) {
            // Step 2: Find the start of the cycle
            slowPtr = *ptrHead;
            Node *prev = NULL; // Keep track of the last node in the cycle

            while (slowPtr != fastPtr) {
                prev = fastPtr;
                slowPtr = slowPtr->next;
                fastPtr = fastPtr->next;
            }

            // Step 3: Remove the cycle
            prev->next = NULL;
            return 1; // Cycle detected and removed
        }
    }
    return 0; // No cycle detected
}

// Function to print the linked list
void printList(Node *node) {
    while (node != NULL) {
        printf("%d", node->data);
        if (node->next != NULL) {
            printf(" -> ");
        }
        node = node->next;
    }
    printf("\n");
}
```



```
PS C:\Users\betti\Desktop\Training\Day16> ./task4
Enter the number of elements in the linked list: 5
Enter element 1: 10
Enter element 2: 20
Enter element 3: 30
Enter element 4: 40
Enter element 5: 50
Initial list: 10 -> 20 -> 30 -> 40 -> 50
Do you want to create a cycle? (Enter -1 for no cycle or index of node [0-4] to point the last node): 2
Cycle created: last node points to node with data 30.
Cycle detected and removed.
Updated list: 10 -> 20 -> 30 -> 40 -> 50
```