Assignment – 1

1. **Write a program to find the maximum element in an array.**

#include <stdio.h>

#include <stdlib.h>

int main()

{

    int n;

    printf("Enter the number of elements in the array: ");

    scanf("%d", &n);

    int arr[n];

    if (n < 1)

    {

        printf("Invalid input\n");

        exit(0);

    }

    printf("Enter the elements of the array: ");

    for (int i = 0; i < n; i++)

    {

        scanf("%d", &arr[i]);

    }

    int max = arr[0];

    for (int i = 1; i < n; i++)

    {

        if (arr[i] > max)

        {

            max = arr[i];

        }

    }

    printf("The maximum element in the array is: %d\n", max);

    return 0;

}

Source Code

Set 1

Enter the number of elements in the array: 0

Invalid input

Set 2

Enter the number of elements in the array: 5

Enter the elements of the array: 2 1 9 7 3

The maximum element in the array is: 9

Ouput

1. **Implement a function to revere an array in place.**

#include <stdio.h>

#include <stdlib.h>

#define max 10

void reverse(int arr[], int n);

int main()

{

    int arr[max], num, pos;

    printf("Enter how many elements you want: ");

    scanf("%d", &num);

    if (num < 1)

    {

        printf("Invalid input\n");

        exit(0);

    }

    printf("Enter the array elements: ");

    for (int i = 0; i < num; ++i)

    {

        scanf("%d", &arr[i]);

    }

    printf("The array is:");

    for (int i = 0; i < num; ++i)

    {

        printf(" %d", arr[i]);

    }

    printf("\n");

    reverse(arr, num);

    printf("The reverse array is:");

    for (int i = 0; i < num; ++i)

    {

        printf(" %d", arr[i]);

    }

    printf("\n");

    return 0;

}

Source Code: main()

void reverse(int arr[], int n)

{

    int temp;

    for (int i = 0; i < n / 2; i++)

    {

        temp = arr[i];

        arr[i] = arr[n - i - 1];

        arr[n - i - 1] = temp;

    }

}

Source Code: reverse()

Set 1

Enter the number of elements in the array: 0

Invalid input

Set 2

Enter how many elements you want: 5

Enter the array elements: 1 2 3 4 5

The array is: 1 2 3 4 5

The reverse array is: 5 4 3 2 1

Ouput

1. **Implement a function to reverse an array in place.**

#include <stdio.h>

#include <stdlib.h>

#define max 10

int \*intersection(int arr1[], int arr2[], int n1, int n2, int \*size);

void main()

{

    int arr1[max], arr2[max], n1, n2, size = 0;

    printf("Enter the number of elements in the first array: ");

    scanf("%d", &n1);

    printf("Enter the elements in the first array: ");

    for (int i = 0; i < n1; i++)

        scanf("%d", &arr1[i]);

    printf("Enter the number of elements in the second array: ");

    scanf("%d", &n2);

    printf("Enter the elements in the second array: ");

    for (int i = 0; i < n2; i++)

        scanf("%d", &arr2[i]);

    int \*temp = intersection(arr1, arr2, n1, n2, &size);

    printf("The intersection of the two arrays is: ");

    for (int i = 0; i < size; i++)

        printf("%d ", temp[i]);

    printf("\n");

}

Source Code: main()

int \*intersection(int arr1[], int arr2[], int n1, int n2, int \*size)

{

    int \*temp = (int \*)malloc(max \* sizeof(int)), k = 0;

    if (n1 > n2)

        intersection(arr2, arr1, n2, n1, size);

    for (int i = 0; i < n1; i++)

        for (int j = 0; j < n2; j++)

            if (arr1[i] == arr2[j])

            {

                int found = 0;

                for (int l = 0; l < k; l++)

                {

                    if (temp[l] == arr1[i])

                    {

                        found = 1;

                        break;

                    }

                }

                if (!found)

                    temp[k++] = arr1[i];

                break;

            }

    \*size = k;

    return temp;

}

Source Code: \*intersection()

()

Enter the number of elements in the first array: 5

Enter the elements in the first array: 6 4 5 8 2

Enter the number of elements in the second array: 3

Enter the elements in the second array: 2 4 3

The intersection of the two arrays is: 4 2

Ouput

1. **Write an algorithm to rotate an array given number of positions.**

#include <stdio.h>

#define max 10

void rotate(int arr[], int n, int pos);

int main()

{

    int num, arr[max], pos;

    printf("Enter how many elements you want: ");

    scanf("%d", &num);

    printf("Enter the array elements: ");

    for (int i = 0; i < num; ++i)

        scanf("%d", &arr[i]);

    printf("The position of rotation: ");

    scanf("%d", &pos);

if (pos < 0)

    {

        printf("Invalid input\n");

        return 0;

    }

    printf("The array is:");

    for (int i = 0; i < num; ++i)

        printf(" %d", arr[i]);

    printf("\n");

    rotate(arr, num, pos);

    printf("The rotated array is:");

    for (int i = 0; i < num; ++i)

        printf(" %d", arr[i]);

    printf("\n");

    return 0;

}

Source Code: main()

void rotate(int arr[], int n, int pos)

{

    // Adjust position to be within bounds

    if (pos > n)

        pos = pos % n;

    // Create a temporary array to hold the rotated values

    int temp[max];

    for (int i = 0; i < n; i++)

        temp[(i + pos) % n] = arr[i];

    // Step 3: Copy back from temp to arr

    for (int i = 0; i < n; i++)

        arr[i] = temp[i];

}

Source Code: rotate()

()

Enter how many elements you want: 5

Enter the array elements: 1 2 3 4 5

The position of rotation: 3

The array is: 1 2 3 4 5

The rotated array is: 3 4 5 1 2

Ouput

1. **Implement an algorithm to find the missing number in an array of integers from 1 to N.**

#include <stdio.h>

#include <stdlib.h>

#define max 10

int main(int argc, char const \*argv[])

{

int arr[max], num, sum = 0, expected\_sum = 0;

printf("Enter how many elements you want (up to %d): ", max);

scanf("%d", &num);

if (num > max)

{

printf("Number exceeds maximum limit of %d.\n", max);

return 1; // Exit if the number exceeds the limit

}

printf("Enter the elements (from 1 to %d): ", num);

for (int i = 0; i < num; i++)

scanf("%d", &arr[i]);

for (int i = 0; i < num - 1; i++)

sum += arr[i]; // Sum of entered numbers

// Calculate the expected sum of the first 'num' natural numbers

expected\_sum = num \* (num + 1) / 2;

// Find the missing number

printf("The missing number is: %d\n", expected\_sum - sum);

return 0;

}

Source Code: main()

Enter how many elements you want (up to 10): 5

Enter the elements (from 1 to 5): 1 3 4 5 6

The missing number is: 2

Ouput

Assignment – 2

1. **Write a function to remove duplicates from sorted array.**

#include <stdio.h>

#define MAX 10

void remove\_duplicate(int \*arr, int \*num);

int main()

{

    int arr[MAX], num;

    printf("Enter how many elements you want (max %d): ", MAX);

    scanf("%d", &num);

    if (num <= 0 || num > MAX)

    {

        printf("\n\tInvalid input!\n\n");

        return 1; // Exit on invalid input

    }

    printf("Enter the array elements: ");

    for (int i = 0; i < num; i++)

    {

        scanf("%d", &arr[i]);

    }

    remove\_duplicate(arr, &num);

    printf("The array after remove duplicate is: ");

    for (int i = 0; i < num; i++)

    {

        printf(" %d", arr[i]);

    }

    printf("\n");

    return 0;

}

Source Code: main()

void remove\_duplicate(int \*arr, int \*num)

{

    int temp[MAX], k = 0; // Start k at 0

    for (int i = 0; i < \*num; i++)

    {

        int flag = 0;               // Reset flag for each element

        for (int j = 0; j < k; j++) // Check against current unique elements

        {

            if (arr[i] == temp[j])

            {

                flag = 1;

                break; // Break early if a duplicate is found

            }

        }

        if (!flag)

        {

            temp[k++] = arr[i]; // Only add if not a duplicate

        }

    }

    \*num = k; // Update the count of unique elements

    for (int i = 0; i < k; i++)

    {

        arr[i] = temp[i]; // Copy unique elements back to original array

    }

}

Source Code: remove\_duplicate()

()

Enter how many elements you want (max 10): 5

Enter the array elements: 1 2 2 8 8

The array after remove duplicate is: 1 2 8

Ouput

1. **Implement an algorithm to find the majority element in an array.**

#include <stdio.h>

#define MAX 10

int main(int argc, char const \*argv[])

{

int arr[MAX], num;

printf("How many elements you want: ");

scanf("%d", &num);

printf("Enter the array elements: ");

for (int i = 0; i < num; ++i) // For inserting array elements

scanf("%d", &arr[i]);

int foundMajority = 0; // Flag to track if a majority element is found

for (int i = 0; i < num; ++i) // Calculating the frequency of each element

{

int frequency = 0;

for (int j = 0; j < num; ++j)

{

if (arr[i] == arr[j])

{

frequency++;

}

}

if (frequency > num / 2)

{

printf("Majority element is: %d", arr[i]);

foundMajority = 1; // Set the flag to indicate a majority element is found

break;

}

}

if (!foundMajority) // Check if no majority element was found

printf("No majority element exists");

return 0;

}

Source Code: main()

How many elements you want: 5

Enter the array elements: 6 5 5 4 2

Majority element is: 5

Ouput

1. **Create a program to find the largest subarray with a sum less than or equal to a given value.**

#include <iostream>

#include <climits> // Use INT\_MIN from <climits>

using namespace std;

int main()

{

    int arr[] = {1, 2, 3, 4, 5}, len = INT\_MIN, givenSum = 6;

    int start = -1, end = -1; // Initialize start and end

    cout << "The array is: ";

    for (int i = 0; i < sizeof(arr) / sizeof(arr[0]); i++)

        cout << arr[i] << " ";

    cout << "\nThe given sum is: " << givenSum;

    for (int i = 0; i < sizeof(arr) / sizeof(arr[0]); i++)

    {

        int sum = 0;

        for (int j = i; j < sizeof(arr) / sizeof(arr[0]); j++)

        {

            // for (int k = i; k <= j; k++) // Change to <= to include arr[j]

            sum += arr[j];

            if (sum <= givenSum)

            {

                if (j - i + 1 > len) // Update length and start/end indices

                {

                    len = j - i + 1;

                    start = i;

                    end = j;

                }

            }

        }

    }

    if (start == -1 && end == -1)

        cout << "No subarray found with the given sum." << endl;

    else

    {

        cout << "\nThe longest subarray of sum " << givenSum << " is: [";

        for (int i = start; i <= end; i++)

        {

            cout << arr[i];

            if (i < end)

                cout << ", ";

        }

        cout << "]" << endl;

    }

    return 0;

}

Source Code: main()

The array is: 1 2 3 4 5

The given sum is: 6

The longest subarray of sum 6 is: [1, 2, 3]

Ouput

1. **Write a function to find the contiguous subarray with the largest sum (Kadane’s algorithm).**

#include <iostream>

#include <climits>

using namespace std;

int largestSumSubarray(int \*, int \*);

int main()

{

    int arr[] = {3, -4, 5, 4, -1, 7, -8};

    int size = sizeof(arr) / sizeof(arr[0]);

    cout << "The array is: ";

    for (int i = 0; i < sizeof(arr) / sizeof(arr[0]); i++)

        cout << arr[i] << " ";

    cout << "\nThe largest sum subarray is " << largestSumSubarray(arr, &size);

}

Source Code: main()

int largestSumSubarray(int \*arr, int \*size)

{

    int maxSum = INT\_MIN, currSum = 0;

    for (int i = 0; i < \*size; i++)

    {

        currSum += arr[i];

        maxSum = max(currSum, maxSum);

        if (currSum < 0)

            currSum = 0;

    }

    return maxSum;

}

Source Code: largestSumSubarray()

The array is: 3 -4 5 4 -1 7 -8

The largest sum subarray is 15

Ouput

1. **Implement an algorithm to search for an element in a sorted and rotated array (rotated binary search).**

#include <iostream>

#include <climits>

using namespace std;

int binarySearch(int \*, int \*, int \*, int \*);

int main()

{

    int arr[] = {4, 5, 6, 1, 2, 3}, target = 5;

    int start = 0, end = (sizeof(arr) / sizeof(arr[0]) - 1);

    int result = binarySearch(arr, &start, &end, &target);

    cout << "The array is: ";

    for (int i = 0; i < sizeof(arr) / sizeof(arr[0]); i++)

        cout << arr[i] << " ";

    cout << "\nThe target element is: " << target;

    if (result == -1)

    {

        cout << "\nElement not present in the array!\n\n";

        exit(0);

    }

    cout << "\nThe element found at " << result + 1 << "th position\n\n";

}

Source Code: main()

The array is: 4 5 6 1 2 3

The target element is: 5

The element found at 2th position

Ouput

int binarySearch(int \*arr, int \*start, int \*end, int \*target)

{

    int mid = \*start + (\*end - \*start) / 2;

    if (arr[mid] == \*target)

        return mid;

    if (arr[\*start] <= arr[mid]) // Left sorted or not

    {

        if (arr[\*start] <= \*target <= arr[mid]) // Checks the target will exists in left or not

        {

            if (\*target < arr[mid])

            {

                \*end = mid - 1;

                return binarySearch(arr, start, end, target);

            }

            else

            {

                \*start = mid + 1;

                return binarySearch(arr, start, end, target);

            }

        }

    }

    else // Right sorted

    {

        if (arr[mid] <= \*target <= arr[\*end]) // Checks the target will exists in right or not

        {

            if (\*target < arr[mid])

            {

                \*end = mid - 1;

                return binarySearch(arr, start, end, target);

            }

            else

            {

                \*start = mid + 1;

                return binarySearch(arr, start, end, target);

            }

        }

    }

    return -1;

}

Source Code: binarySearch()

()

Assignment – 3

1. **Create a single linked list and write a function to reverse it.**

#include <iostream>

#include <cstdlib>

using namespace std;

typedef struct node

{

    int data;

    node \*next;

} node;

node \*head = NULL;

node \*createNode(int);

void insertNode(int);

void displayList();

void freeList();

void reverseList();

int main()

{

    int choice, value;

    while (true)

    {

        cout << "\nMenu:\n";

        cout << "1. Insert Node\n";

        cout << "2. Reverse List\n";

        cout << "0. Exit\n";

        displayList();

        cout << "Enter your choice: ";

        cin >> choice;

        switch (choice)

        {

        case 1:

            cout << "Enter value to insert: ";

            cin >> value;

            insertNode(value);

            break;

        case 2:

            reverseList();

            break;

        case 0:

            freeList();

            cout << "Exiting...\n"

                 << endl;

            exit(0);

        default:

            cout << "Invalid choice. Try again." << endl;

        }

    }

    return 0;

}

Source Code: main()

void insertNode(int data)

{

    node \*p, \*temp = createNode(data);

    if (head == NULL)

        head = temp;

    else

    {

        p = head;

        while (p->next != NULL)

            p = p->next;

        p->next = temp;

    }

}

Source Code: insertNode(data)

()

node \*createNode(int data)

{

    node \*newNode = new node();

    newNode->data = data;

    newNode->next = NULL;

    return newNode;

}

Source Code: \*createNode(data)

()

void displayList()

{

    if (!head)

    {

        cout << "\n\tList is empty!\n"

             << endl;

        return;

    }

    node \*p = head;

    cout << "\n\tList is: ";

    while (p != NULL)

    {

        cout << p->data << "->";

        p = p->next;

    }

    cout << "NULL\n"

         << endl;

}

Source Code: displayList()

()

void reverseList()

{

    if (head == NULL || head->next == NULL)

        return;

    node \*prevNode = head,

         \*currNode = prevNode->next;

    while (currNode != NULL)

    {

        node \*nextNode = currNode->next;

        currNode->next = prevNode;

        // Updated

        prevNode = currNode;

        currNode = nextNode;

    }

    head->next = NULL;

    head = prevNode;

}

Source Code: reverseList()

()

void freeList()

{

    node \*temp;

    while (head != nullptr)

    {

        temp = head;

        head = head->next;

        delete temp;

    }

    cout << "\nAll nodes freed." << endl;

}

Source Code: freeList()

()

Menu:

1. Insert Node

2. Reverse List

0. Exit

List is empty!

Enter your choice: 1

Enter value to insert: 10

Menu:

1. Insert Node

2. Reverse List

0. Exit

List is: 10🡪NULL

Enter your choice: 1

Enter value to insert: 20

Menu:

1. Insert Node

2. Reverse List

0. Exit

List is: 10🡪20🡪NULL

Enter your choice: 1

Enter value to insert: 30

Menu:

1. Insert Node

2. Reverse List

0. Exit

List is: 10🡪20🡪30🡪NULL

Enter your choice: 2

Menu:

1. Insert Node

2. Reverse List

0. Exit

List is: 30🡪20🡪10🡪NULL

Enter your choice: 0

All nodes freed.

Exiting...

Ouput

1. **Implement a program to detect if a linked list has a cycle.**

#include <iostream>

using namespace std;

typedef struct node

{

    int data;

    node \*next;

} node;

node \*head = NULL;

node \*createNode(int);

node \*checkCycle(); // Function to detect and handle cycle (to be implemented by you)

void createCyclicList();

void displayList();

void freeList();

int main()

{

    createCyclicList(); // Create a hardcoded list with a cycle

    displayList();      // Display the list

    if (!checkCycle()) // Call the function to detect a cycle

        cout << "\n\tIn this list cycle not present!"

             << endl;

    else

        cout << "\n\tIn this list cycle present!"

             << endl;

    freeList(); // Cleanup

    cout << "\tExiting...\n"

         << endl;

    return 0;

}

Source Code: main()

node \*createNode(int data)

{

    node \*newNode = new node();

    newNode->data = data;

    newNode->next = NULL;

    return newNode;

}

Source Code: \*createNode(data)

()

void createCyclicList()

{

    // Create nodes

    node \*node1 = createNode(1);

    node \*node2 = createNode(2);

    node \*node3 = createNode(3);

    node \*node4 = createNode(4);

    node \*node5 = createNode(5);

    // Link nodes to form a list

    head = node1;

    node1->next = node2;

    node2->next = node3;

    node3->next = node4;

    node4->next = node5;

    // Create a cycle (node5 points back to node2)

    node5->next = node2; // Change to node2 to create a cycle

}

Source Code: createCyclicList()

()

void displayList()

{

    if (!head)

    {

        cout << "\n\tList is empty!\n"

             << endl;

        return;

    }

    node \*p = head;

    int count = 0; // Prevent infinite loop for cyclic list

    cout << "\n\tList is: ";

    while (p != NULL && count < 12)

    {

        cout << p->data << "->";

        p = p->next;

        count++;

    }

    if (count == 12)

        cout << "...\n";

    else

        cout << "NULL\n";

}

Source Code: displayList()

()

// Placeholder function for cycle detection

node \*checkCycle()

{

    node \*turtle = head, \*rabbit = head;

    while (rabbit != NULL && rabbit->next != NULL)

    {

        turtle = turtle->next;

        rabbit = rabbit->next->next;

        if (turtle == rabbit)

            return turtle;

    }

    return NULL;

}

Source Code: \*checkCycle()

()

void freeList()

{

    if (!head)

    {

        cout << "\n\tList is already empty." << endl;

        return;

    }

    // Use checkCycle to detect the meeting point if there's a cycle

    node \*meetingPoint = checkCycle();

    if (meetingPoint != NULL) // If a cycle exists

    {

        node \*slow = head;

        // Find the start of the cycle

        while (slow->next != meetingPoint->next)

        {

            slow = slow->next;

            meetingPoint = meetingPoint->next;

        }

        // Break the cycle

        meetingPoint->next = NULL;

    }

    // Free the list nodes

    node \*temp;

    while (head != nullptr)

    {

        temp = head;

        head = head->next;

        delete temp;

    }

    cout << "\n\tAll nodes freed." << endl;

}

Source Code: freeList()

()

List is: 1->2->3->4->5->2->3->4->5->2->3->4->...

In this list cycle present!

All nodes freed.

Exiting...

Ouput

List is: 1->2->3->4->5->NULL

In this list cycle not present!

All nodes freed.

Exiting...

Ouput

1. **Write a function to merge two sorted linked list into a single linked list.**

#include <iostream>

using namespace std;

typedef struct node

{

    int data;

    node \*next;

} node;

node \*head1 = NULL;

node \*head2 = NULL;

node \*createNode(int);

node \*createList();

node \*mergeList();

void displayList(node \*);

void freeList(node \*);

int main()

{

    cout << "\nFor the 1st list\n";

    cout << "-----------------\n";

    head1 = createList();

    cout << "\nFor the 2nd list\n";

    cout << "-----------------\n";

    head2 = createList();

    cout << '\n';

    cout << "1st List: ";

    displayList(head1);

    cout << "2nd List: ";

    displayList(head2);

    cout << "Merge List: ";

    node \*mergedList = mergeList();

    displayList(mergedList);

    freeList(mergedList); // Cleanup

    cout << "Exiting...\n";

    return 0;

}

Source Code: main()

void displayList(node \*head)

{

    if (!head)

    {

        cout << "Empty!\n"

             << endl;

        return;

    }

    node \*p = head;

    while (p != NULL)

    {

        cout << p->data << "->";

        p = p->next;

    }

    cout << "NULL\n"

         << endl;

}

Source Code: displayList()

()

node \*createNode(int data)

{

    node \*newNode = new node();

    newNode->data = data;

    newNode->next = NULL;

    return newNode;

}

Source Code: \*createNode(data)

()

void freeList()

{

    node \*temp;

    while (head1 != nullptr)

    {

        temp = head1;

        head1 = head1->next;

        delete temp;

    }

    while (head2 != nullptr)

    {

        temp = head2;

        head2 = head2->next;

        delete temp;

    }

    cout << "\nAll nodes freed." << endl;

}

Source Code: freeList()

()

node \*mergeList()

{

    node \*p1 = head1, \*p2 = head2;

    node \*dummy = new node(), \*p3 = dummy;

    while (p1 != NULL && p2 != NULL)

    {

        if (p1->data < p2->data)

        {

            p3->next = p1;

            p1 = p1->next;

        }

        else

        {

            p3->next = p2;

            p2 = p2->next;

        }

        p3 = p3->next;

    }

    while (p1 != NULL)

    {

        p3->next = p1;

        p1 = p1->next;

        p3 = p3->next;

    }

    while (p2 != NULL)

    {

        p3->next = p2;

        p2 = p2->next;

        p3 = p3->next;

    }

    return dummy->next;

}

Source Code: \*mergeList()

()

For the 1st list

-----------------

Enter the number of nodes: 5

Enter value for node 1: 1

Enter value for node 2: 2

Enter value for node 3: 4

Enter value for node 4: 6

Enter value for node 5: 8

For the 2nd list

-----------------

Enter the number of nodes: 4

Enter value for node 1: 3

Enter value for node 2: 5

Enter value for node 3: 7

Enter value for node 4: 9

1st List: 1->2->4->6->8->NULL

2nd List: 3->5->7->9->NULL

Merge List: 1->2->3->4->5->6->7->8->9->NULL

All nodes freed.

Exiting...

Ouput

node \*createList()

{

    int n, value;

    cout << "Enter the number of nodes: ";

    cin >> n;

    if (n <= 0)

    {

        cout << "List size must be greater than 0.\n";

        return NULL;

    }

    // Create the head node

    cout << "Enter value for node 1: ";

    cin >> value;

    node \*head = createNode(value);

    node \*current = head;

    // Create the remaining nodes

    for (int i = 2; i <= n; ++i)

    {

        cout << "Enter value for node " << i << ": ";

        cin >> value;

        current->next = createNode(value);

        current = current->next;

    }

    return head;

}

Source Code: \*createList()

()

1st List: 1->2->4->6->8->NULL

2nd List: 3->5->7->9->NULL

Merge List: 1->2->3->4->5->6->7->8->9->NULL

All nodes freed.

Exiting...

Ouput