LAB ASSIGNMENT

DATA STRUCTURES & ALGORITHM

ARRAYS

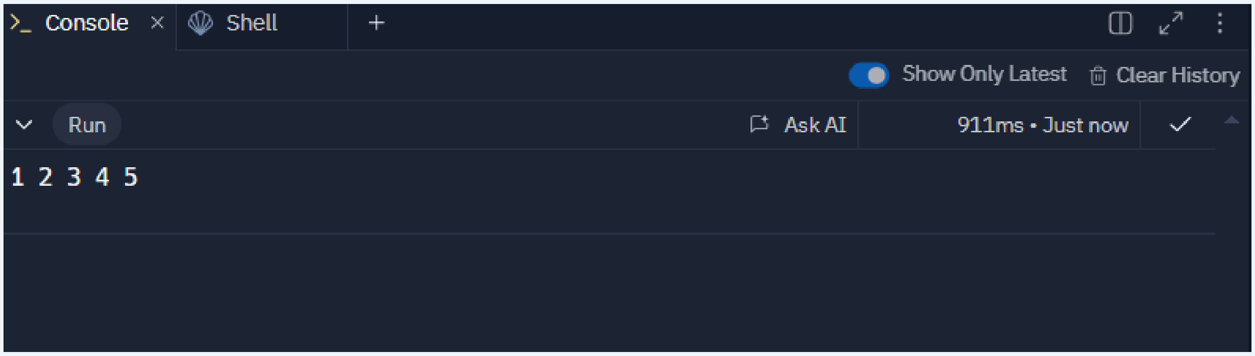
1. Write a program to initialize an array of integers and print all the elements

CODE

```
#include <iostream>

using namepsace std;

int main() {

   int arr[] = {1, 2, 3, 4, 5}; // Initializing array with 5 integers

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


   for (int i = 0; i < length; i++) {

      cout << arr[i] << " ";

   }


   return 0;
```

```
}
```

OUTPUT



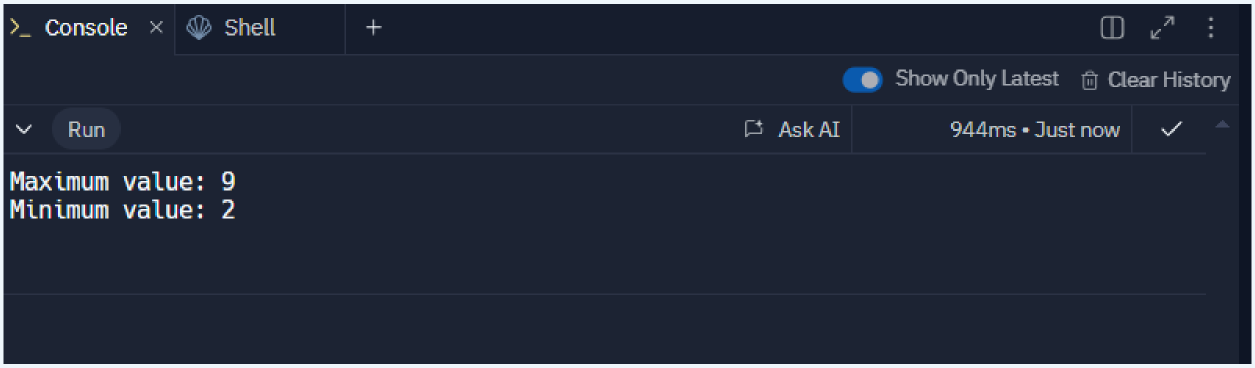
2. Create a program that finds the maximum and minimum values in an array.

CODE

```
#include <iostream>

Using namespace std;

#include <algorithm> // For max and min


int main()

 {

   int arr[] = {3, 6, 4, 1, 8, 9, 2, 6, 5, 3}; //Array initializationn

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


   int maxVal = arr[0];

   int minVal = arr[0];
```

```
    for (int i = 1; i < length; i++) {
        if (arr[i] > maxVal) {
            maxVal = arr[i];
        }
        if (arr[i] < minVal)
{
            minVal = arr[i];
        }
    }

   cout << "Maximum Value: " << maxVal << endl;
    cout << "Minimum Value: " << minVal << endl;

    return 0;
}
```

OUTPUT



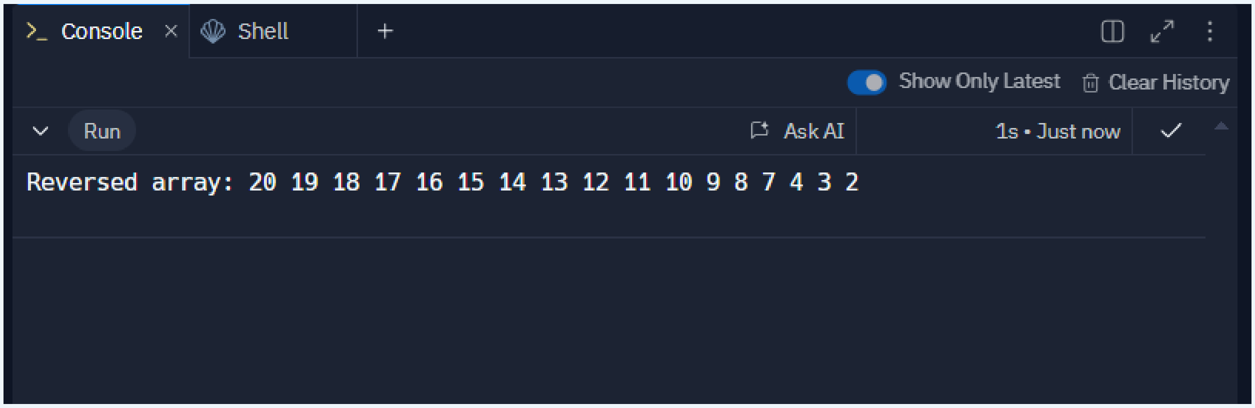
3. Write a program that reverses the elements of an array.

CODE

```
#include <iostream>

using namespace std;

#include <algorithm> // For reverse


int main() {

    int arr[] = {2,3,4,7,8,9,10,11,12,13,14,15,16,17,18,19,20};

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


    reverse(arr, arr + length); // Reverse the array


    cout << "Reversed array: ";

    for (int i = 0; i < length; i++) {

        cout << arr[i] << " ";

    }
```

```
    return 0;

}
```

OUTPUT



LISTS

1. Implement a program to add and display elements in a linked list.

CODE

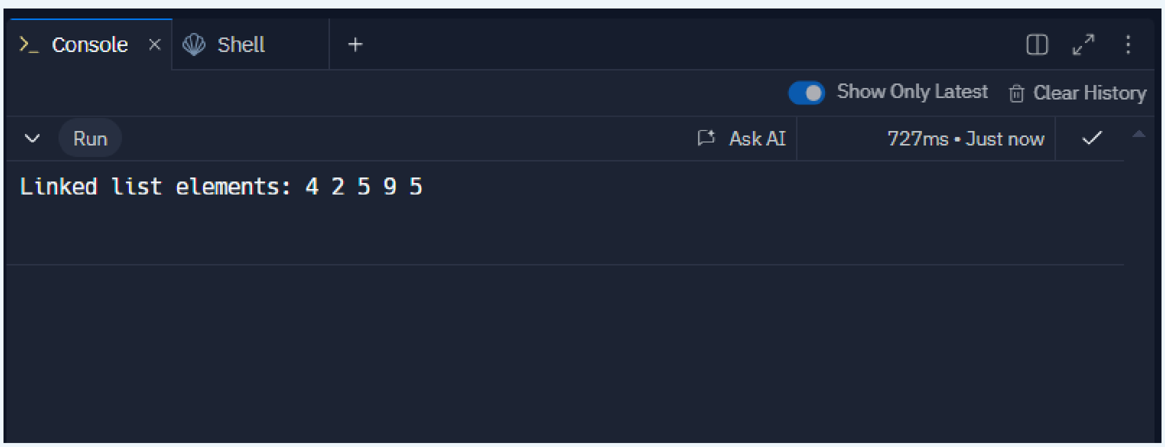
```
#include <iostream>

using namespace std;


// Node structure

struct Node

{

    int data;
```

```
    Node* next;
};

// Function to add a new node at the end
void addNode(Node*& head, int value)
{
    Node* newNode = new Node();
    newNode->data = value;
    newNode->next = nullptr;

    if (head == nullptr)
{
        head = newNode;
    } else
{
        Node* temp = head;
        while (temp->next != nullptr)
 {
            temp = temp->next;
        }
        temp->next = newNode;
    }
```

```
}

// Function to display the linked list
void displayList(Node* head)
{
    Node* temp = head;
    while (temp != nullptr)
{
        cout << temp->data << " ";
        temp = temp->next;
    }
  cout << endl;
}

int main() {
    Node* head = nullptr; // Initialize an empty list

    // Add elements to the list
    addNode(head, 4);
    addNode(head, 2);
    addNode(head, 5);
    addNode(head, 9);
```

```
    addNode(head, 5);

    // Display the list
    cout << "Linked list elements: ";
    displayList(head);

    return 0;
}
```

OUTPUT



2. Implement a program to remove and display elements in a linked list.

CODE

```
#include <iostream>
using namespace std;
// Node structure
```

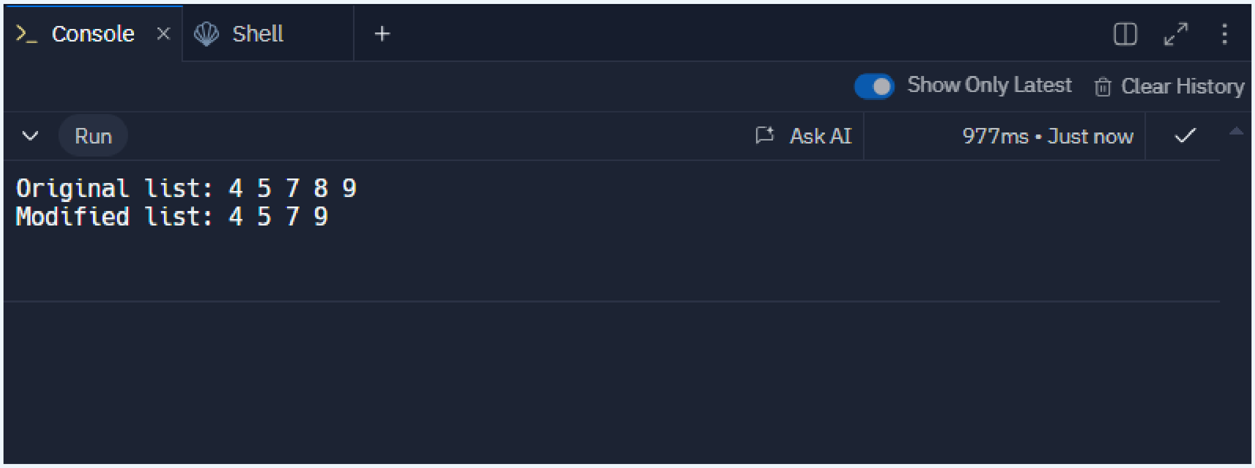
```
struct Node
{
    int data;
    Node* next;
};

// Function to add a new node at the end
void addNode(Node*& head, int value) {
    Node* newNode = new Node();
    newNode->data = value;
    newNode->next = nullptr;

    if (head == nullptr) {
        head = newNode;
    } else {
        Node* temp = head;
        while (temp->next != nullptr) {
            temp = temp->next;
        }
        temp->next = newNode;
    }
}
```

```
// Function to remove a node with a specific value
void removeNode(Node*& head, int value) {
    if (head == nullptr) return;

    // If head needs to be removed
    if (head->data == value) {
        Node* temp = head;
        head = head->next;
        delete temp;
        return;
    }

    Node* temp = head;
    while (temp->next != nullptr && temp->next->data != value) {
        temp = temp->next;
    }

    if (temp->next == nullptr) return; // Value not found

    Node* nodeToDelete = temp->next;
    temp->next = temp->next->next;
```

```
    delete nodeToDelete;
}

// Function to display the linked list
void displayList(Node* head) {
    Node* temp = head;
    while (temp != nullptr) {
        cout << temp->data << " ";
        temp = temp->next;
    }
   cout << endl;
}

int main() {
    Node* head = nullptr; /
/ Initialize an empty list

    // Add elements to the list
    addNode(head, 4);
    addNode(head, 5);
    addNode(head, 7);
    addNode(head, 8);
```

```
    addNode(head, 9);

    // Display the list
    scout << "Original list: ";
    displayList(head);

    // Remove elements from the list
    removeNode(head, 2);
    removeNode(head, 8);

    // Display the list after removal
  cout << "Modified list: ";
    displayList(head);

    return 0;
}
```

OUTPUT



3. Write a program that searches for an element in a linked list.

CODE

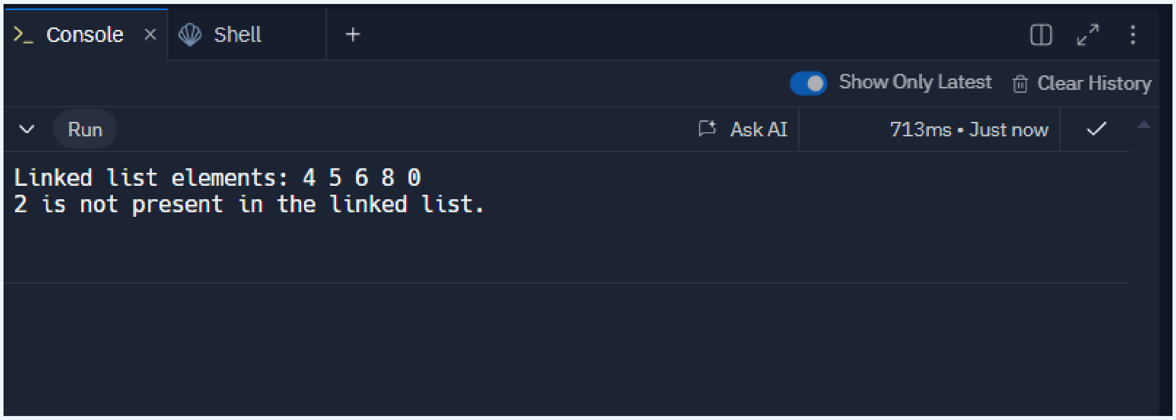
```
#include <iostream>

using namespace std;

// Node structure

struct Node

 {

    int data;

    Node* next;

};


// Function to add a new node at the end

void addNode(Node*& head, int value) {

    Node* newNode = new Node();

    newNode->data = value;
```

```
    newNode->next = nullptr;

    if (head == nullptr) {
        head = newNode;
    } else {
        Node* temp = head;
        while (temp->next != nullptr) {
            temp = temp->next;
        }
        temp->next = newNode;
    }
}

// Function to search for an element
bool searchElement(Node* head, int value) {
    Node* temp = head;
    while (temp != nullptr) {
        if (temp->data == value) {
            return true;
        }
        temp = temp->next;
    }
```

```
    return false;
}

// Function to display the linked list
void displayList(Node* head)
{
    Node* temp = head;
    while (temp != nullptr)
 {
       cout << temp->data << " ";
        temp = temp->next;
    }
    cout << endl;
}

int main() {
    Node* head = nullptr;
// Initialize an empty list

    // Add elements to the list
    addNode(head, 4);
    addNode(head, 5);
```

```
    addNode(head, 6);
    addNode(head, 8);
    addNode(head, 0);

    // Display the list
    cout << "Linked list elements: ";
    displayList(head);

    // Search for an element
    int searchValue = 2;
    if (searchElement(head, searchValue))
{
      cout << searchValue << " is present in the linked list." << endl;
    } else {
      cout << searchValue << " is not present in the linked list." << endl;
    }

    return 0;
}
```

OUTPUT



4. Create a program to insert an element at the beginning of linked list.

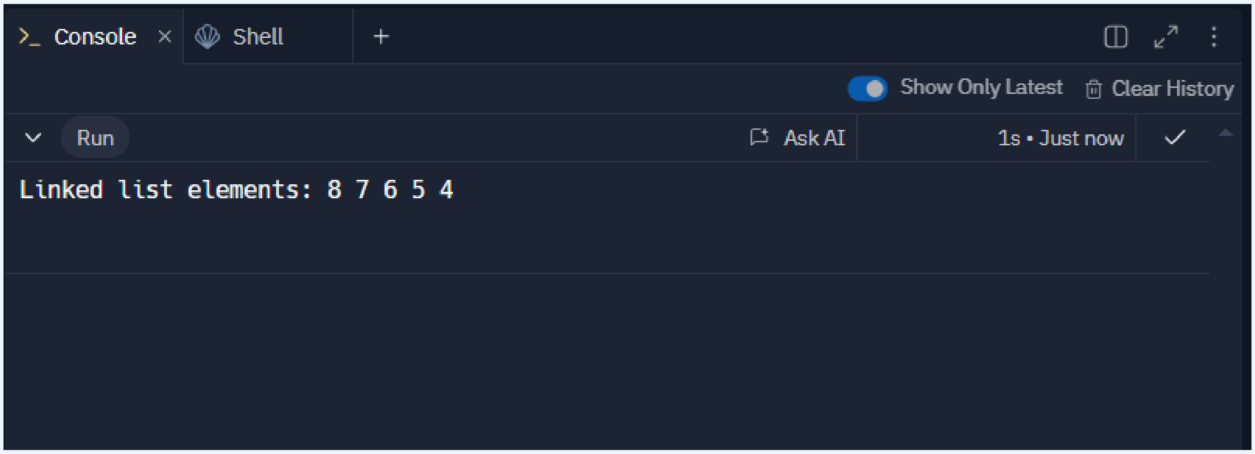
CODE

```
#include <iostream>

Using namespace std;


// Node structure

struct Node {

    int data;

    Node* next;

};


// Function to add a new node at the beginning

void addNodeAtBeginning(Node*& head, int value) {

    Node* newNode = new Node();

    newNode->data = value;

    newNode->next = head;
```

```
    head = newNode;
}

// Function to display the linked list
void displayList(Node* head) {
    Node* temp = head;
    while (temp != nullptr) {
      cout << temp->data << " ";
        temp = temp->next;
    }
    std::cout << std::endl;
}

int main() {
    Node* head = nullptr; // Initialize an empty list

    // Add elements to the list
    addNodeAtBeginning(head, 4);
    addNodeAtBeginning(head, 5);
    addNodeAtBeginning(head, 6);
    addNodeAtBeginning(head, 7);
    addNodeAtBeginning(head, 8);
```

```
    // Display the list
    std::cout << "Linked list elements: ";
    displayList(head);

    return 0;
}
```

OUTPUT



5. Create a program to insert an element at the middle of linked list.

CODE

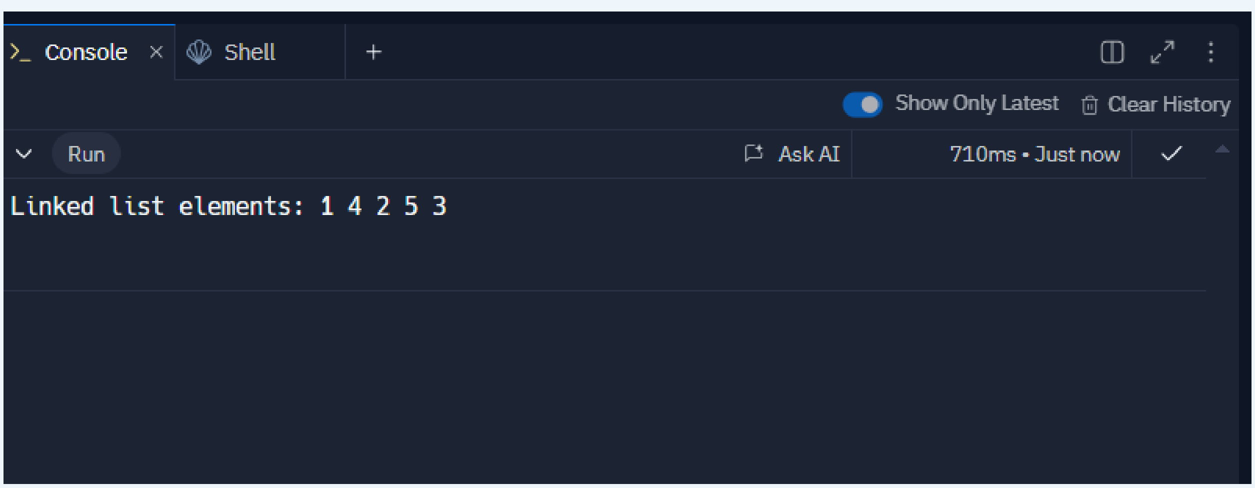
```
#include <iostream>
using namespace std;

// Node structure
```

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

// Function to add a new node at the middle
void addNodeAtMiddle(Node*& head, int value)
 {
    Node* newNode = new Node();
    newNode->data = value;

    if (head == nullptr || head->next == nullptr)
{
        newNode->next = head;
        head = newNode;
        return;
    }

    Node* slow = head;
    Node* fast = head;
```

```
    while (fast->next != nullptr && fast->next->next != nullptr)
 {
        slow = slow->next;
        fast = fast->next->next;
    }

    newNode->next = slow->next;
    slow->next = newNode;
}

// Function to display the linked list
void displayList(Node* head) {
    Node* temp = head;
    while (temp != nullptr) {
        cout << temp->data << " ";
        temp = temp->next;
    }
   cout << endl;
}

int main() {
    Node* head = nullptr; // Initialize an empty list
```

```
    // Add elements to the list
    addNodeAtMiddle(head, 3);
    addNodeAtMiddle(head, 1);
    addNodeAtMiddle(head, 4);
    addNodeAtMiddle(head, 5);
    addNodeAtMiddle(head, 2);

    // Display the list
   cout << "Linked list elements: ";
    displayList(head);

    return 0;
}
```

OUTPUT



STACKS

1. Implement a stack using an array and perform push and pop operations.

CODE

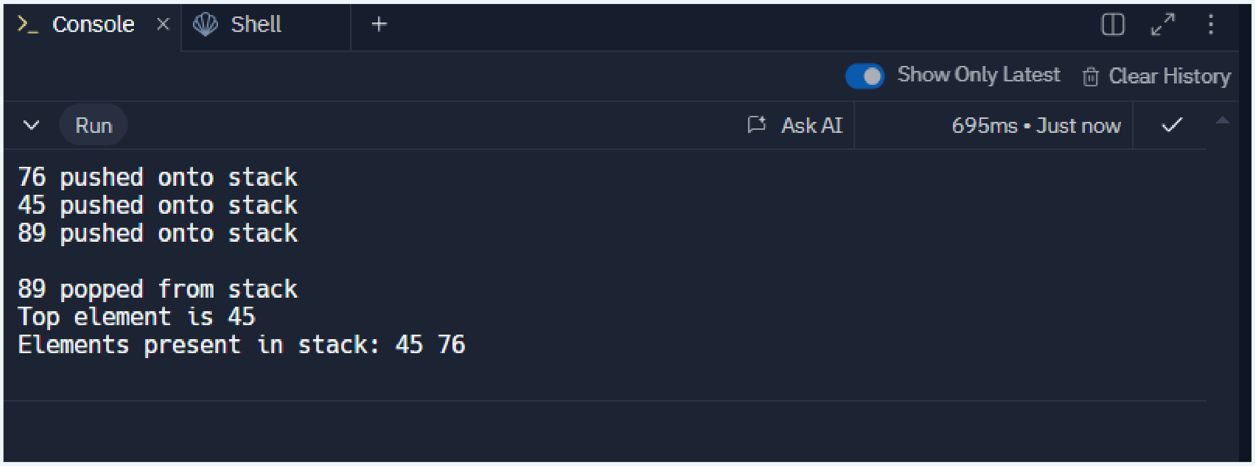
```
#include <iostream>
 using namespace std;

#define MAX 1000 // Define the maximum size of the stack

class Stack {
    int top;
    int arr[MAX]; // Array to store stack elements

public:
    Stack() { top = -1; } // Constructor to initialize top

    // Function to push an element onto the stack
    bool push(int x) {
        if (top >= (MAX - 1)) {
            cout << "Stack Overflow" << endl;
            return false;
        } else {
```

```
        arr[++top] = x;
        cout << x << " pushed onto stack" << endl;
        return true;
    }
}

// Function to pop an element from the stack
int pop() {
    if (top < 0) {
        cout << "Stack Underflow" << endl;
        return 0;
    } else {
        int x = arr[top--];
        return x;
    }
}

// Function to display the top element of the stack
int peek() {
    if (top < 0) {
        cout << "Stack is Empty" << endl;
        return 0;
```

```
        } else {
            return arr[top];
        }
    }

    // Function to check if the stack is empty
    bool isEmpty() {
        return (top < 0);
    }
};

int main() {
    Stack stack;
    stack.push(76);
    stack.push(45);
    stack.push(89);

    cout << stack.pop() << " popped from stack" << endl;
    cout << "Top element is " << stack.peek() << endl;

    cout << "Elements present in stack: ";
    while (!stack.isEmpty()) {
```

```
        cout << stack.pop() << " ";
    }

    return 0;
}
```

OUTPUT



2. Write a program to check if a given string of parentheses is balanced (e.g., “(())” is balanced, but “(()” is not).

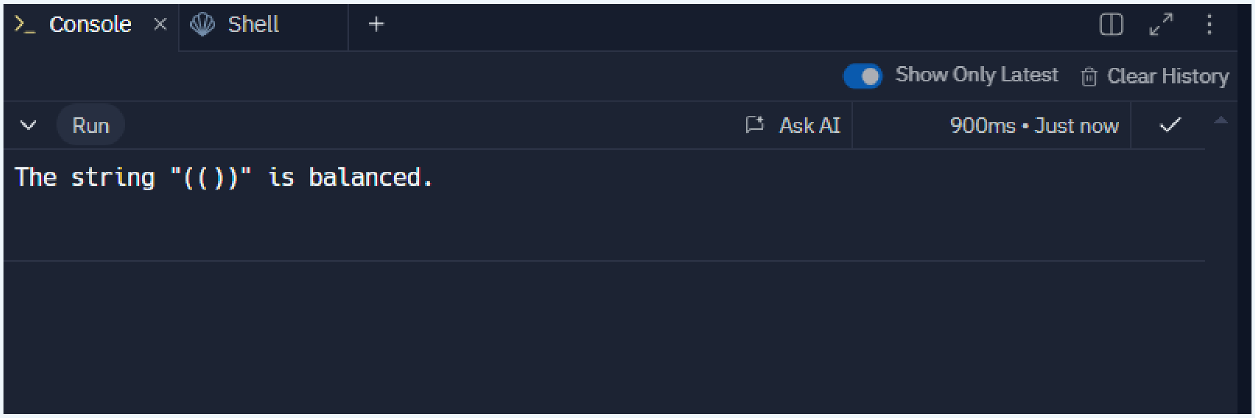
CODE

```
#include <iostream>

#include <stack>

#include <string>

 using namespace std;


bool isBalanced(string expr)

 {
```

```
    stack<char> s;
    for (char ch : expr)
{
        if (ch == '(')
{
            s.push(ch);
        } else if (ch == ')')
{
            if (s.empty() || s.top() != '(')
{
                return false;
            }
            s.pop();
        }
    }
    return s.empty();
}

int main()
{
    string expr = "(())"; // Example input
```

```
    if (isBalanced(expr))
{
        cout << "The string \"" << expr << "\" is balanced." << endl;
    }
else
{
        cout << "The string \"" << expr << "\" is not balanced." << endl;
    }

    return 0;
}
```

OUTPUT



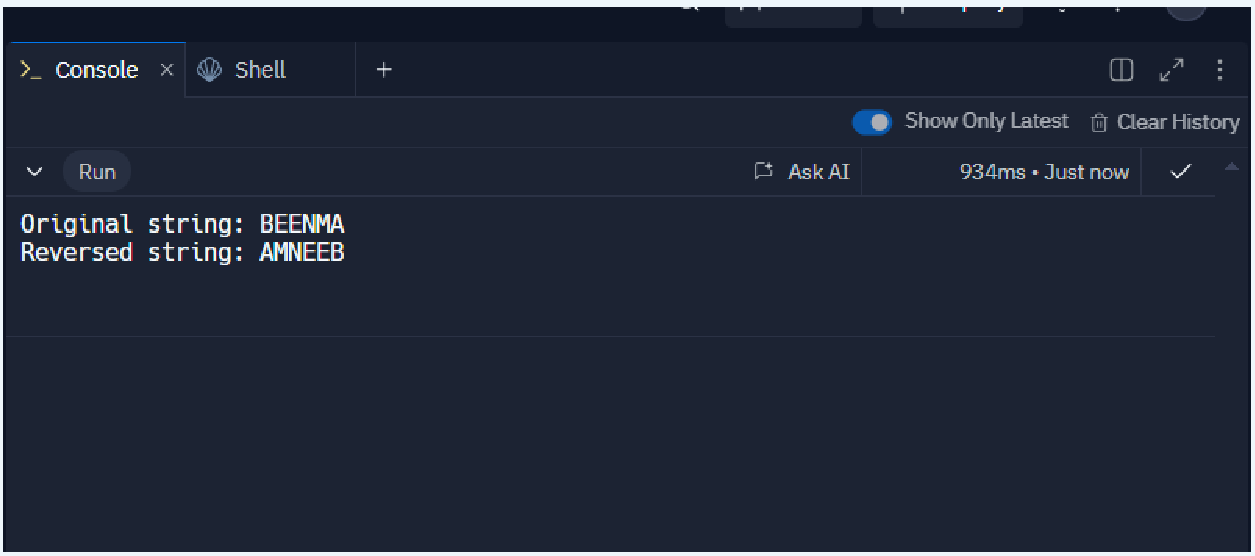
3. Create a stack-based program to reverse a string (push each character and pop to reverse).

CODE

```
#include <iostream>

#include <stack>

#include <string>

using namespace std;


string reverseString(const string& str) {

    stack<char> s;

    for (char ch : str) {

        s.push(ch);

    }


    string reversed;

    while (!s.empty()) {

        reversed += s.top();

        s.pop();

    }


    return reversed;

}


int main() {

    string str = "hello"; // Example input
```

```
    string reversedStr = reverseString(str);

    cout << "Original string: " << str << endl;
    cout << "Reversed string: " << reversedStr << endl;

    return 0;
}
```

OUTPUT



QUEUES

1. Write a program to check if the elements in a queue form a palindrome. A palindrome reads the same forwards and backwards (e.g., `{1, 2, 3, 2, 1}`).

CODE

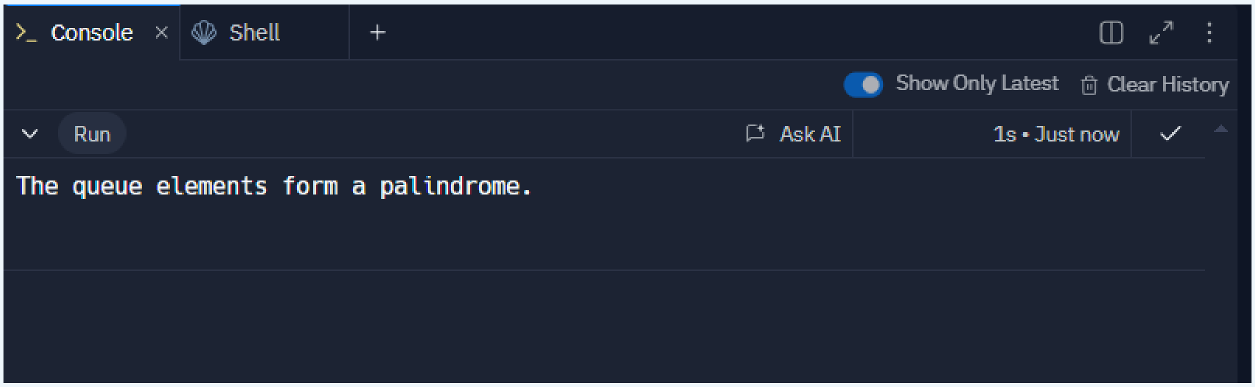
```
#include <iostream>
```

```
#include <queue>
#include <stack>
#include <vector>

using namespace std;

bool isPalindrome(queue<int> q) {
    stack<int> s;
    vector<int> original;

    while (!q.empty()) {
        int value = q.front();
        q.pop();
        original.push_back(value);
        s.push(value);
    }

    for (int i = 0; i < original.size(); i++) {
        if (original[i] != s.top()) {
            return false;
        }
        s.pop();
```

```
    }

    return true;
}

int main() {
    queue<int> q;

    // Example input
    q.push(1);
    q.push(2);
    q.push(3);
    q.push(2);
    q.push(1);

    if (isPalindrome(q)) {
        cout << "The queue elements form a palindrome." << endl;
    } else {
        cout << "The queue elements do not form a palindrome." << endl;
    }

    return 0;
```

```
}
```

OUTPUT



2. Implement a simple program that counts the total number of elements in a queue without modifying the queue's order.

CODE

```
#include <iostream>

#include <queue>

using namespace std;


int countQueueElements(queue<int> q) {

    int count = 0;

    while (!q.empty()) {

        count++;

        q.pop();

    }
```

```
    return count;
}

int main() {
    queue<int> q;

    // Example input
    q.push(1);
    q.push(2);
    q.push(3);
    q.push(4);
    q.push(5);

    int totalElements = countQueueElements(q);
    cout << "Total number of elements in the queue: " << totalElements << endl;

    return 0;
}
```

OUTPUT

3. Write a program to simulate a basic ticket queue, where people enter and leave the line in the order they joined.

CODE

```
#include <iostream>

#include <queue>

#include <string>


using namespace std;


int main() {

    queue<string> ticketQueue;


    // Simulate people entering the queue

    ticketQueue.push("Alice");

    ticketQueue.push("Bob");

    ticketQueue.push("Charlie");

    ticketQueue.push("Diana");
```

```
    ticketQueue.push("Eve");

    // Display the queue
    cout << "People in the ticket queue: ";
    queue<string> tempQueue = ticketQueue; // Copy queue to display without
modifying original
    while (!tempQueue.empty()) {
        cout << tempQueue.front() << " ";
        tempQueue.pop();
    }
    cout << endl;

    // Simulate people leaving the queue
    while (!ticketQueue.empty()) {
        cout << ticketQueue.front() << " got the ticket and left the queue." << endl;
        ticketQueue.pop();
    }

    return 0;
}
```

OUTPUT

```
People in the ticket queue:
Amna
Ayesha
Ahmed
Sana
Maryam

Amna got the ticket and left the queue.
Ayesha got the ticket and left the queue.
Ahmed got the ticket and left the queue.
Sana got the ticket and left the queue.
Maryam got the ticket and left the queue.
```

VECTORS

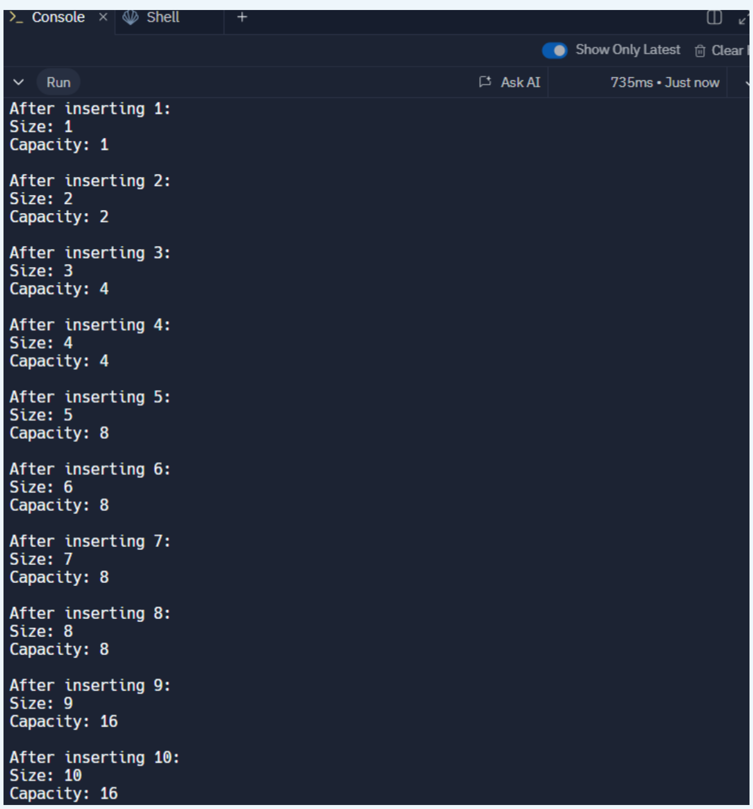
1. Write a program to add elements to a vector and display its size and capacity after each insertion.

CODE

```
#include <iostream>

#include <vector>



using namespace std;



int main()

 {

    vector<int> vec;
```

```
    for (int i = 1; i <= 10; ++i) {
        vec.push_back(i);
        cout << "After inserting " << i << ": " << endl;
        cout << "Size: " << vec.size() << endl;
        cout << "Capacity: " << vec.capacity() << endl << endl;
    }

    return 0;
}
```

OUTPUT




```
After inserting 1:
Size: 1
Capacity: 1

After inserting 2:
Size: 2
Capacity: 2

After inserting 3:
Size: 3
Capacity: 4

After inserting 4:
Size: 4
Capacity: 4

After inserting 5:
Size: 5
Capacity: 8

After inserting 6:
Size: 6
Capacity: 8

After inserting 7:
Size: 7
Capacity: 8

After inserting 8:
Size: 8
Capacity: 8

After inserting 9:
Size: 9
Capacity: 16

After inserting 10:
Size: 10
Capacity: 16
```

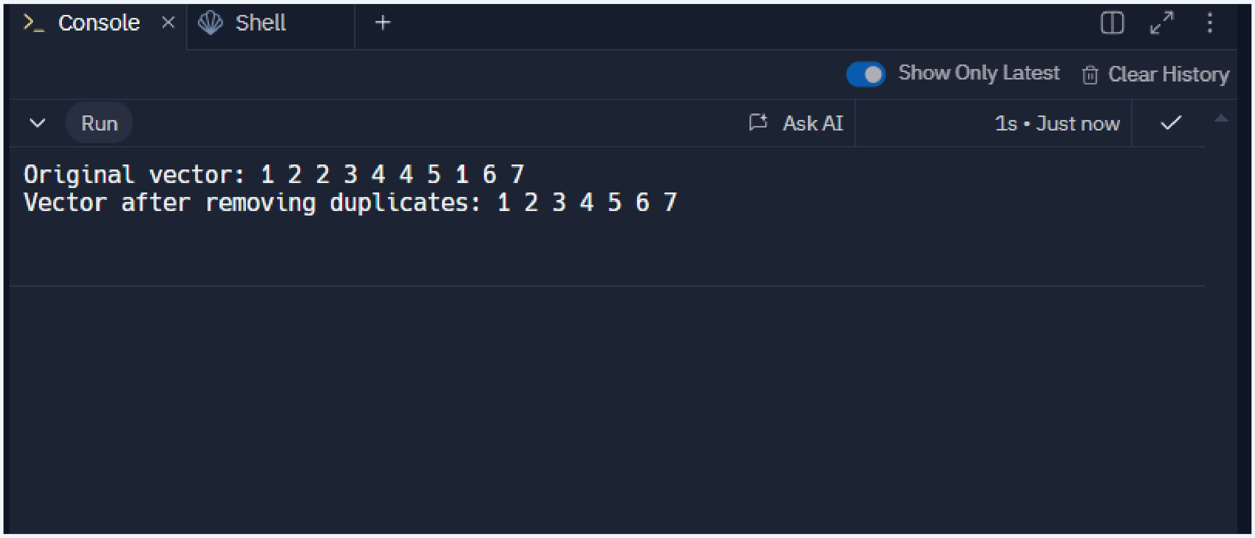
2. Implement a program that removes duplicate values from a vector.

CODE

```
#include <iostream>

#include <vector>

#include <algorithm>

#include <unordered_set>


using namespace std;


void removeDuplicates(vector<int>& vec) {

    unordered_set<int> seen;

    auto end = remove_if(vec.begin(), vec.end(), [&seen](int value) {

        if (seen.find(value) != seen.end()) {

            return true;

        } else {

            seen.insert(value);

            return false;

        }

    });

    vec.erase(end, vec.end());

}
```

```
int main()
{
    vector<int> vec = {1, 2, 2, 3, 4, 4, 5, 1, 6, 7};

    cout << "Original vector: ";
    for (int val : vec) {
        cout << val << " ";
    }
    cout << endl;

    removeDuplicates(vec);

    cout << "Vector after removing duplicates: ";
    for (int val : vec) {
        cout << val << " ";
    }
    cout << endl;

    return 0;
}
```

OUTPUT



3. Create a program to sort a vector of integers in ascending order.

CODE

```
#include <iostream>

#include <vector>

#include <algorithm>


using namespace std;


int main() {

    vector<int> vec = {5, 1, 4, 2, 8}; // Example vector


    cout << "Original vector: ";

    for (int val : vec) {

        cout << val << " ";
```

```
    }
    cout << endl;

    sort(vec.begin(), vec.end()); // Sorting the vector in ascending order

    cout << "Sorted vector: ";
    for (int val : vec) {
        cout << val << " ";
    }
    cout << endl;

    return 0;
}
```

OUTPUT