Experiment 2

Student Name: Karan Goyal | **UID:-22BCS15864**
Branch: BE-CSE | **Section/Group: Ntpp-602-A**
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Aim:-To solve the "Two Sum" and "Implement Queue Using Stacks" problems by designing efficient algorithms that meet the problem requirements while ensuring correct and optimal performance.

Objective:-The objective is to develop solutions for the "Two Sum" and "Queue Using Stacks" problems. For "Two Sum", implement an algorithm that finds two numbers adding up to a target. For "Queue Using Stacks", design a queue with push, pop, peek, and empty operations using two stacks, ensuring efficient FIFO behavior.

Apparatus Used:

1. **Software**: -Leetcode
2. **Hardware**: Computer with 4 GB RAM and keyboard.

Problem Statement(2.1): Given an array of integers nums and an integer target, return the indices of the two numbers such that they add up to target. Each input has exactly one solution, and you cannot use the same element twice.

Algorithm for the Two Sum Problem:

1. **Input**: An array nums[] of integers and an integer target.
2. **Output**: Return a pair of indices i and j such that nums[i] + nums[j] = target.

Steps:

1. Start by determining the size n of the nums[] array.
2. Loop through the array using the first index i (from 0 to n-2).
3. Inside the first loop, use a second loop with index j (starting from i + 1 to n-1).
4. For each pair of indices (i, j), check if the sum of the elements at these indices, nums[i] + nums[j], is equal to target.
5. If the sum is equal to target, return the indices [i, j].
6. If no pair is found after checking all possible pairs, return an empty array [].

Code:

```
class Solution {
public:
  vector<int> twoSum(vector<int>& nums, int target) {
    int n = nums.size();
    for (int i = 0; i < n - 1; i++) {
      for (int j = i + 1; j < n; j++) {
        if (nums[i] + nums[j] == target) {
          return {i, j}; }}
}
            return {};
    }
}
```

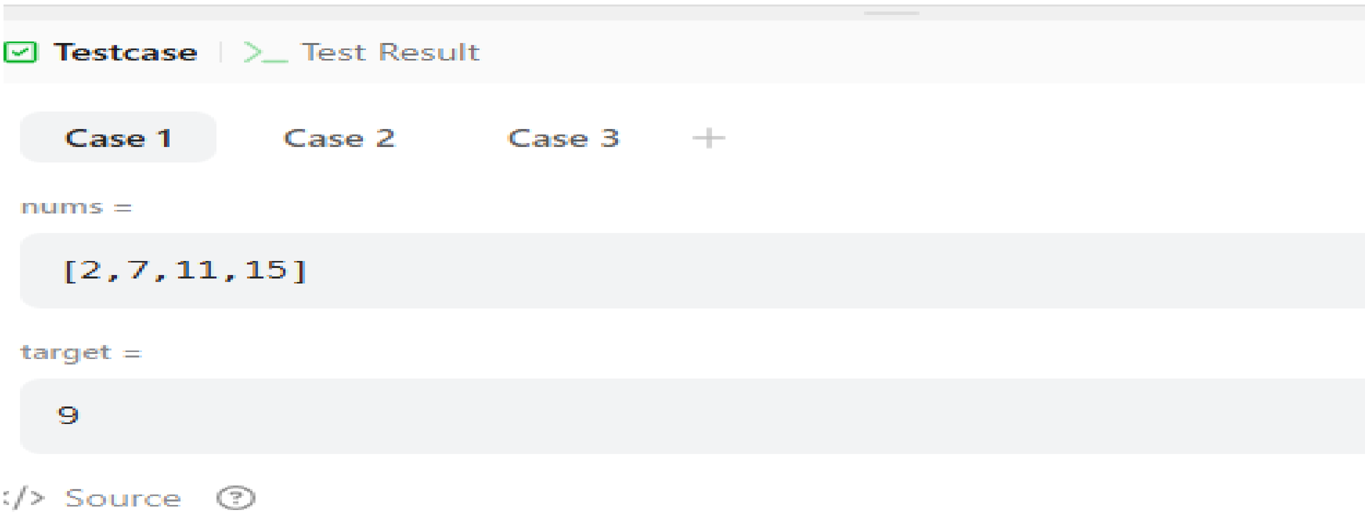
Time Complexity:

- The time complexity of this solution is O(n^2) because of the nested loops where each element is compared with every other element in the array.

Space Complexity:

- The space complexity is O(1) because we are using only a constant amount of space to store the result.

Output- All the test cases passed



Problem Statement: You are given a 0-indexed array nums of length n. You are initially positioned at nums[0]. Each element nums[i] represents the maximum length of a forward jump from index i. Return the minimum number of jumps to reach nums[n - 1]**.**

Algorithm for Implementing Queue Using Stacks:

1. **Input**:

A stack s1 used for queue operations (FIFO behavior).
A stack s2 used temporarily for rearranging elements in the right order.
Operations: push(x), pop(), peek(), and empty().

2. **Operations**:

Push Operation (push(x)):-While s1 is not empty, pop all elements from s1 and push them onto s2 to reverse their order. Push the element x onto s2. While s2 is not empty, pop all elements from s2 and push them back onto s1. This restores the correct order for the queue (FIFO).

Pop Operation (pop()):-The front element of the queue is at the top of s1, so pop and return the top element of s1.
Peek Operation (peek()):-The front element of the queue is still at the top of s1, return the top element of s1 without popping
Empty Operation (empty()):-Return true if s1 is empty, otherwise return false.

Code-

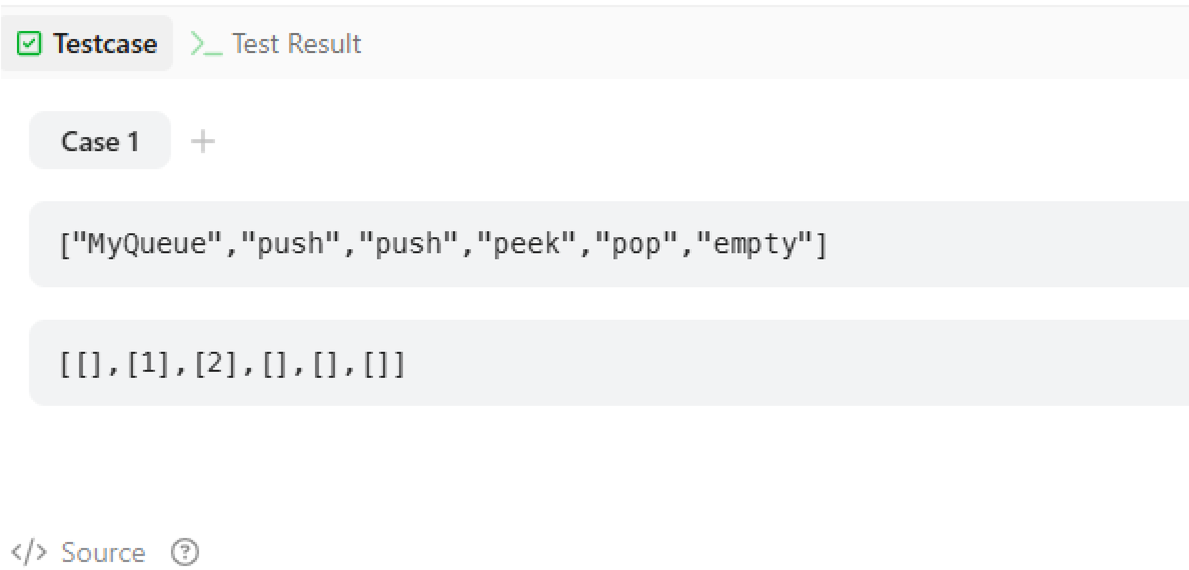
```
class MyQueue {

public:

stack<int> s1;
stack<int> s2;

        MyQueue() { }

 void push(int x) {

 while(!s1.empty()) {

 s2.push(s1.top());
s1.pop();   }

 s2.push(x);

while(!s2.empty()) {

 s1.push(s2.top());
s2.pop();  }}

   int pop() {

 int curr = s1.top();
s1.pop();
return curr;  }

int peek() {  return s1.top(); }

  bool empty() {
return s1.empty();

}};
```

Time Complexity:

Push Operation: O(n), where n is the number of elements in the queue, because elements are moved between s1 and s2.
Pop Operation: O(1), as it only involves popping the top element of s1.
Peek Operation: O(1), as it only involves looking at the top element of s1.
Empty Operation: O(1), as it checks if s1 is empty.

Space Complexity:O(n), where n is the number of elements in the queue, because both stacks s1 and s2 hold the elements in the queue at any time.

Result-All test cases passes



Learning Outcomes:

1. Understand the use of two stacks to implement a FIFO queue and array syntaxes.
2. Learn how to manage stack operations to mimic queue behavior.
3. Develop skills in designing efficient algorithms for data structure manipulation.
4. Analyze the time and space complexity of array solutions.
5. Apply problem-solving techniques to implement standard queue operations (push, pop, peek, empty).