



# DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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## WORKSHEET 7

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**Semester: 06**

**Date of Performance: 13/03/2025**

**Subject Name: AP Lab II**

**Subject Code: 22CSP-351**

### 1. Aim:

- a) Climbing Stairs
- b) House Robber
- c) Maximum Subarray

### 2. Source Code:

**a.**

```
class Solution {
public:
    int climbStairs(int n) {
        // dp[i] := the number of ways to climb to the i-th stair
        vector<int> dp(n + 1);
        dp[0] = 1;
        dp[1] = 1;

        for (int i = 2; i <= n; ++i)
            dp[i] = dp[i - 1] + dp[i - 2];

        return dp[n];
    }
};
```

**b.**

```
class Solution {
public:
    int rob(vector<int>& nums) {
        if (nums.empty())
```

```
        return 0;
    if (nums.size() == 1)
        return nums[0];

    // dp[i] := the maximum money of robbing nums[0..i]
    vector<int> dp(nums.size());
    dp[0] = nums[0];
    dp[1] = max(nums[0], nums[1]);

    for (int i = 2; i < nums.size(); ++i)
        dp[i] = max(dp[i - 1], dp[i - 2] + nums[i]);

    return dp.back();
}
};
```

C.

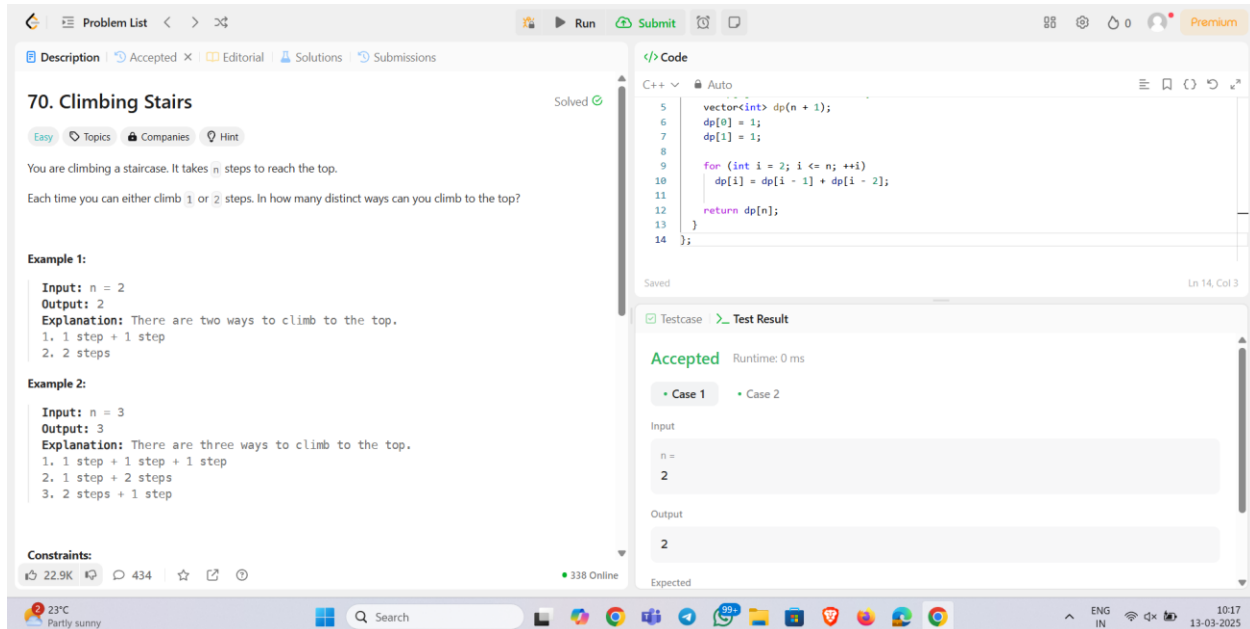
```
class Solution {
public:
    int maxSubArray(vector<int>& nums) {
        // dp[i] := the maximum sum subarray ending in i
        vector<int> dp(nums.size());

        dp[0] = nums[0];
        for (int i = 1; i < nums.size(); ++i)
            dp[i] = max(nums[i], dp[i - 1] + nums[i]);

        return ranges::max(dp);
    }
};
```

## Screenshot of Outputs:

a.

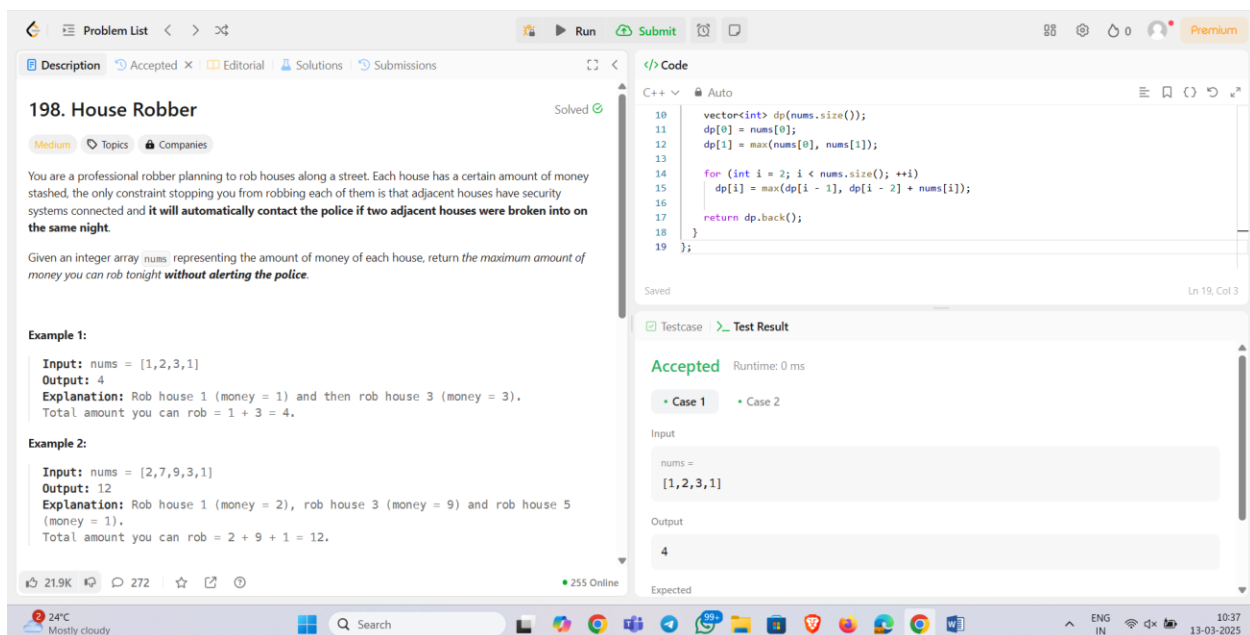


The screenshot shows the LeetCode interface for problem 70, "Climbing Stairs". The problem description states: "You are climbing a staircase. It takes  $n$  steps to reach the top. Each time you can either climb 1 or 2 steps. In how many distinct ways can you climb to the top?". Example 1 shows input  $n = 2$  and output 2. Example 2 shows input  $n = 3$  and output 3. The constraints are  $1 \leq n \leq 45$ . The code editor shows a C++ solution using dynamic programming:

```
C++  
vector<int> dp(n + 1);  
dp[0] = 1;  
dp[1] = 1;  
for (int i = 2; i <= n; ++i)  
    dp[i] = dp[i - 1] + dp[i - 2];  
return dp[n];
```

The test result shows "Accepted" with a runtime of 0 ms. The input field contains  $n = 2$  and the output field contains 2.

b.

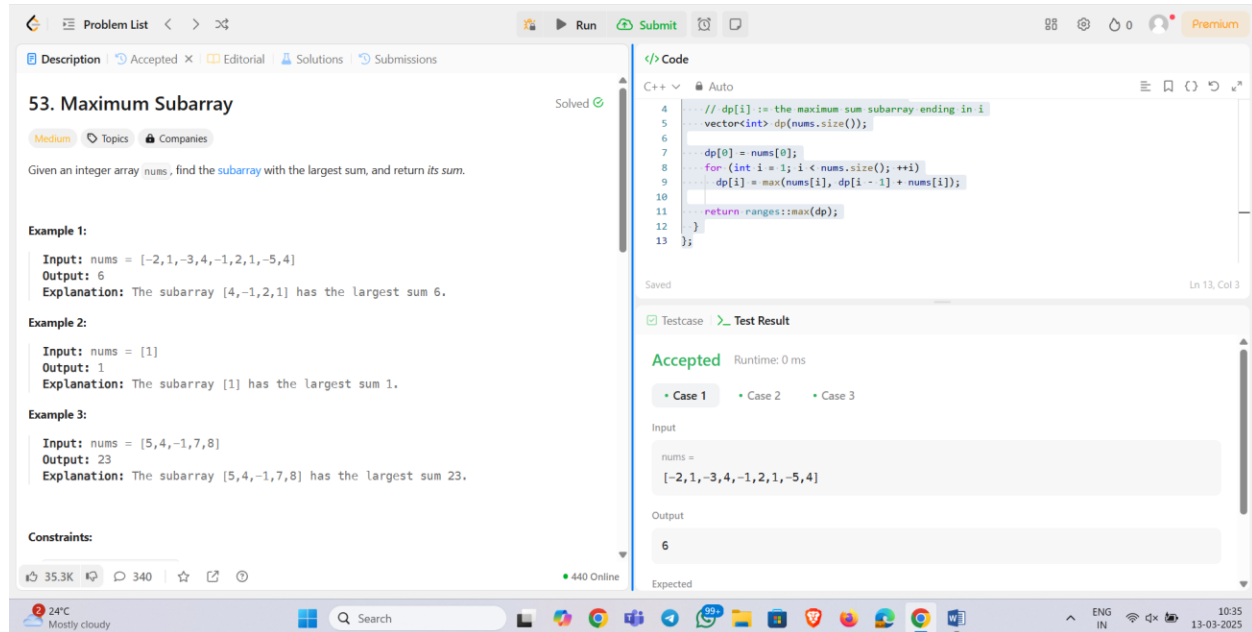


The screenshot shows the LeetCode interface for problem 198, "House Robber". The problem description states: "You are a professional robber planning to rob houses along a street. Each house has a certain amount of money stashed, the only constraint stopping you from robbing each of them is that adjacent houses have security systems connected and it will automatically contact the police if two adjacent houses were broken into on the same night. Given an integer array `nums` representing the amount of money of each house, return the maximum amount of money you can rob tonight without alerting the police." Example 1 shows input `nums = [1,2,3,1]` and output 4. Example 2 shows input `nums = [2,7,9,3,1]` and output 12. The constraints are  $1 \leq \text{nums.length} \leq 100$  and  $0 \leq \text{nums}[i] \leq 400$ . The code editor shows a C++ solution using dynamic programming:

```
C++  
vector<int> dp(nums.size());  
dp[0] = nums[0];  
dp[1] = max(nums[0], nums[1]);  
for (int i = 2; i < nums.size(); ++i)  
    dp[i] = max(dp[i - 1], dp[i - 2] + nums[i]);  
return dp.back();
```

The test result shows "Accepted" with a runtime of 0 ms. The input field contains `nums = [1,2,3,1]` and the output field contains 4.

C.



The screenshot displays a coding interface for the problem "53. Maximum Subarray". The problem description states: "Given an integer array `nums`, find the subarray with the largest sum, and return its sum." It includes three examples: Example 1 with input `nums = [-2,1,-3,4,-1,2,1,-5,4]` and output 6; Example 2 with input `nums = [1]` and output 1; and Example 3 with input `nums = [5,4,-1,7,8]` and output 23. The constraints are listed at the bottom. The code editor shows a C++ solution using dynamic programming. The test results section indicates the solution is "Accepted" with a runtime of 0 ms. The input and output fields show the test case `nums = [-2,1,-3,4,-1,2,1,-5,4]` and the expected output 6.

**53. Maximum Subarray**

Medium Topics Companies

Given an integer array `nums`, find the subarray with the largest sum, and return its sum.

**Example 1:**

Input: `nums = [-2,1,-3,4,-1,2,1,-5,4]`  
Output: 6  
Explanation: The subarray `[4,-1,2,1]` has the largest sum 6.

**Example 2:**

Input: `nums = [1]`  
Output: 1  
Explanation: The subarray `[1]` has the largest sum 1.

**Example 3:**

Input: `nums = [5,4,-1,7,8]`  
Output: 23  
Explanation: The subarray `[5,4,-1,7,8]` has the largest sum 23.

**Constraints:**

- `1 <= nums.length <= 3 * 104`
- `-105 <= nums[i] <= 105`

**Code**

```
C++  
// dp[i] := the maximum sum subarray ending in i  
vector<int> dp(nums.size());  
  
dp[0] = nums[0];  
for (int i = 1; i < nums.size(); ++i)  
    dp[i] = max(nums[i], dp[i - 1] + nums[i]);  
  
return ranges::max(dp);  
};
```

**Testcase** **Test Result**

**Accepted** Runtime: 0 ms

Case 1 Case 2 Case 3

**Input**

`nums = [-2,1,-3,4,-1,2,1,-5,4]`

**Output**

6

**Expected**

6

### 3. Learning Outcomes

- (i) Learned about Dynamic Programming.
- (ii) Learned about top down approach.
- (iii) Learned about bottom up approach.