Experiment- 6A

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Semester:6th **Date of Performance:**20/02/25
Subject Name: AP Lab-2 **Subject Code:** 22CSH-352

1. TITLE:

Climbing Stairs.

2. AIM:

You are climbing a staircase. It takes n steps to reach the top.

3. Algorithm

- **Define a DP array** `dp` where `dp[i]` represents the number of distinct ways to reach the `i-th` stair.
- Initialize base cases:

  `dp[0] = 1` → There is 1 way to stay at the ground without climbing.

  `dp[1] = 1` → There is 1 way to reach the first stair (taking a single step).
- **Iterate from `i = 2` to `n`** and use the recurrence relation:

  dp[i]=dp[i−1]+dp[i−2]
- **Return `dp[n]`**, which contains the total number of ways to reach the `n-th` stair.

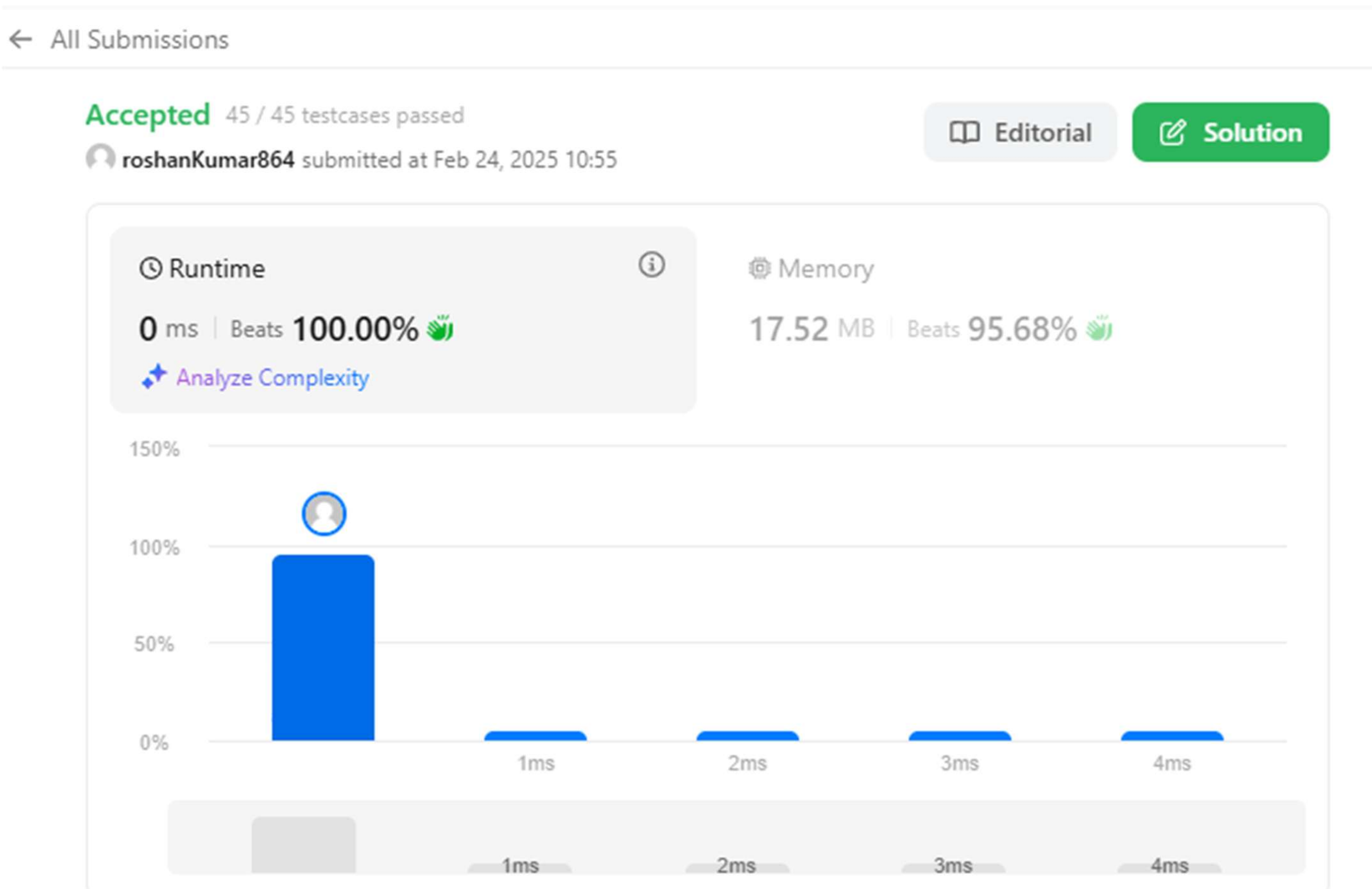
Implemetation/Code

```
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];
    }
};
```

Output:



Time Complexity : O(n)

Space Complexity : O(n)

Learning Outcomes:-

- The given solution is a **bottom-up DP** approach, where smaller subproblems are solved first.
- This makes it an ideal candidate for **DP** rather than a naive recursive approach (which has exponential complexity).

Experiment - 6B

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1. **TITLE:**

   Maximum Subarray.

2. **AIM:**
   Given an integer array nums, find the subarray with the largest sum, and return *its sum*.

3. **Algorithm**

- **Define DP array `dp[i]`**, where:

  `dp[i]` represents the **maximum sum subarray that ends at index `i`.**

  This ensures that every subarray considered **includes `nums[i]`**

- Base Case:
  `dp[0] = nums[0]` → The maximum sum subarray ending at index `0` is the element itself.
- State Transition (Recurrence Relation):
  For each `i` from `1` to `n-1`, compute:
  dp[i]=max (nums[i],dp[i−1]+nums[i])dp[i] = \max(nums[i], dp[i - 1] + nums[i])dp[i]=max(nums[i],dp[i−1]+nums[i])
- Final Answer:
  The overall maximum sum subarray is obtained by computing: max(dp[0],dp[1],…,dp[n−1])\max(dp[0], dp[1], \dots, dp[n-1])max(dp[0],dp[1],…,dp[n−1])

Implemetation/Code:

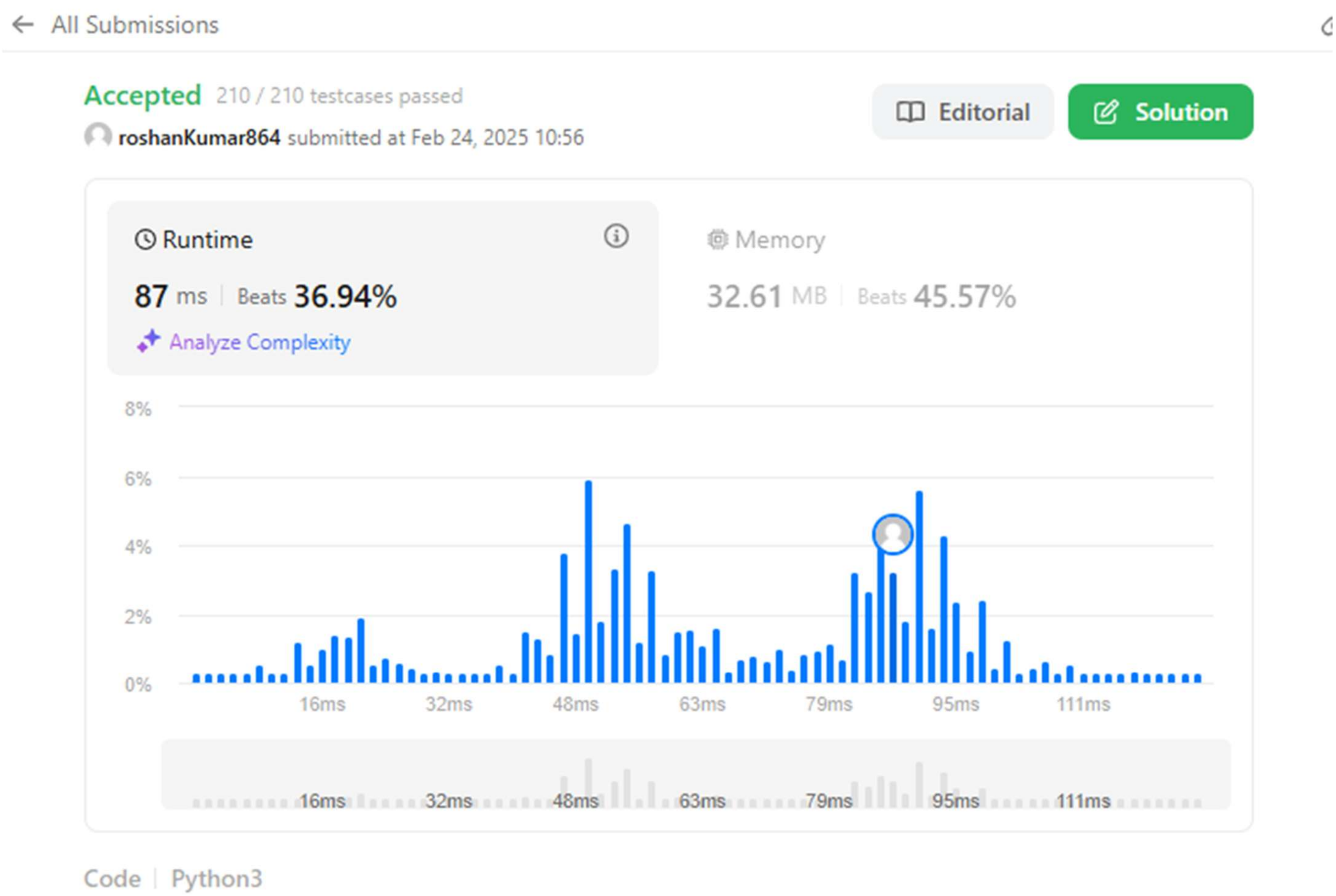
```
class Solution {
class Solution {
public:
int maxSubArray(vector<int>& nums) {
// dp[i] := the maximum sum subarray ending in i
vector<int> dp(nums.size());

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);
}
};
```

Output:



Time Complexity : O(N)

Space Complexity : O(1)

Learning Outcomes:-

- Recognizing **overlapping subproblems** (each subarray solution builds on the previous).
- The optimized approach shows the **power of greedy techniques** in reducing space complexity.