Experiment-7

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Subject Name: Advanced Programming Lab-2 **Subject Code: 22ITP-351**

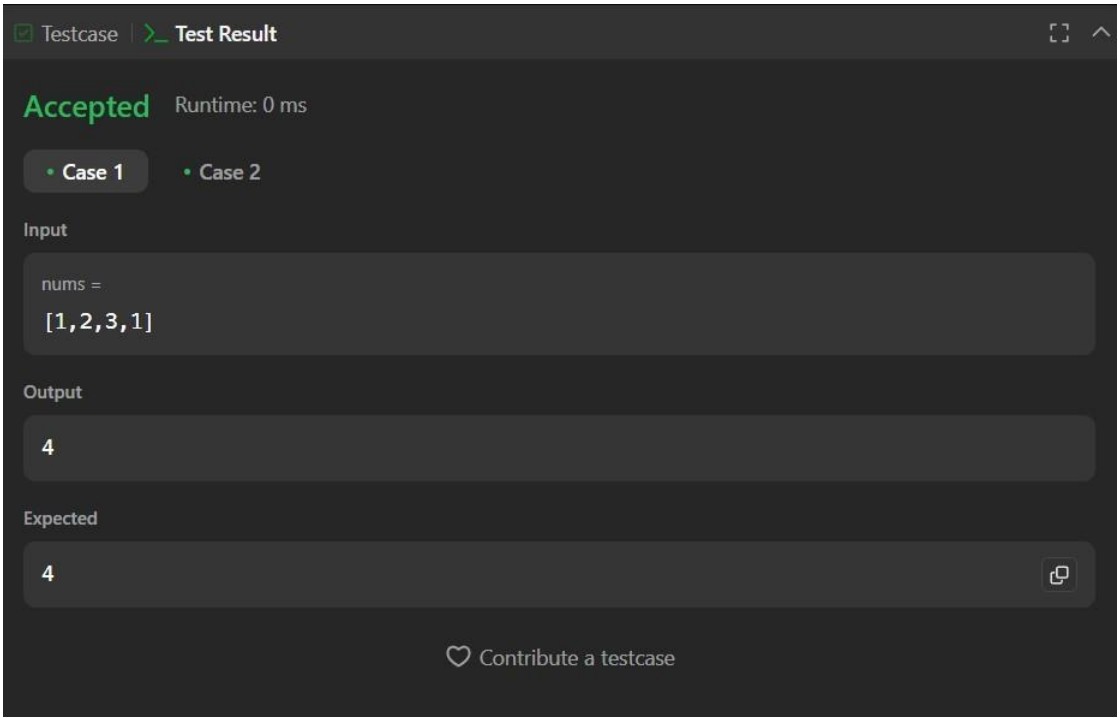
Problem 1- House Robber

Aim -You are given an array nums representing the amount of money in each house along a street. You cannot rob two adjacent houses. Find the maximum amount of money you can rob without alerting the police.

Code:

```
class Solution
{ public:
   int rob(vector<int>& nums)
      { int n = nums.size();

      if (n == 1)
         { return
         nums[0];
      }

      vector<int> dp(n, 0);

      dp[0] = nums[0];
      dp[1] = max(nums[0], nums[1]);

      for (int i = 2; i < n; i++) {
         dp[i] = max(dp[i - 1], nums[i] + dp[i - 2]);
      }

      return dp[n - 1];
   }
};
```

Output:



Problem 2-Jump Game

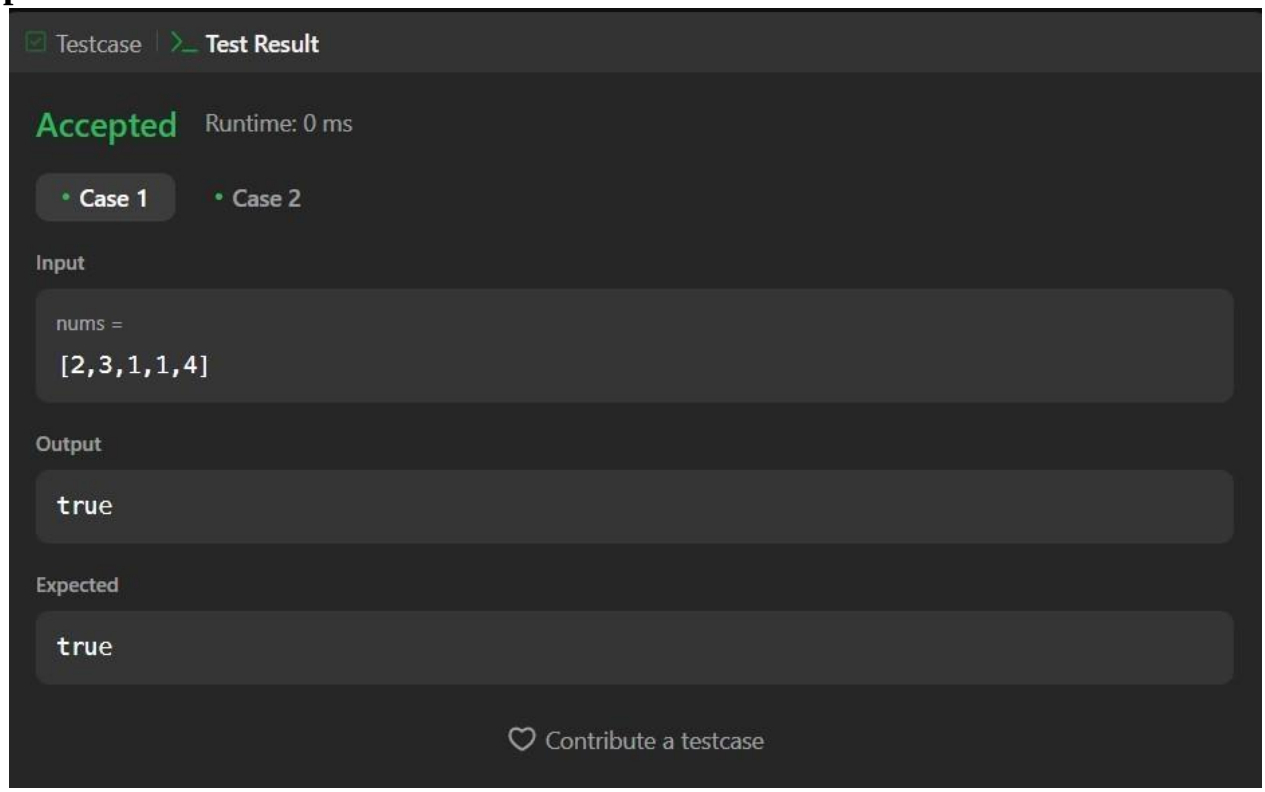
Aim :- Given an array nums where nums[i] represents the maximum jump length from index i, determine if you can reach the last index starting from index 0.

Code:

```
class Solution
{ public:
   bool canJump(vector<int>& nums)
      { int goal = nums.size() - 1;
      for (int i = nums.size() - 1; i >= 0; i--)
         { if (i + nums[i] >= goal)
            { goal = i;
         }
      }
```

```
            return goal == 0;
        }
    };
```

Output:



Problem 3:-Unique Paths

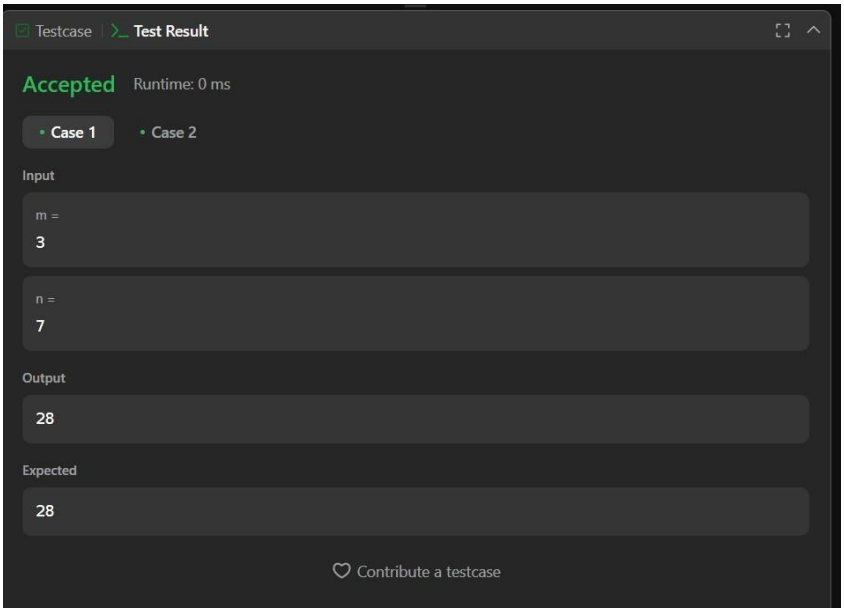
Aim- Given the two integers m and n, return the number of possible unique paths that the robot can take to reach the bottom-right corner.

Code:

```
class Solution
{ public:
//     int f(int m,int n,vector<vector<int>>& dp){
//         if(m==0 && n==0) return 1;
//         if(m<0 || n<0) return 0;
//         if(dp[m][n]!=-1) return dp[m][n];
//         int up = f(m-1,n,dp);
```

```
//         int left = f(m,n-1,dp);
//         return dp[m][n] = up+left;
//     }
    int uniquePaths(int m, int n)
        { int dp[m][n];
        // tabulation
        dp[0][0]=1;
        for(int i = 0 ; i<m ;
            i++){ for(int j = 0 ; j<n ;
            j++){
                if(i==0 && j==0) continue;
                int up=0,left=0;
                if(i>0) up = dp[i-1][j];
                if(j>0) left = dp[i][j-1];
                dp[i][j] = up + left;
            }
        }
        return dp[m-1][n-1];
    }
};
```

Output:



Problem 4:- Coin Change

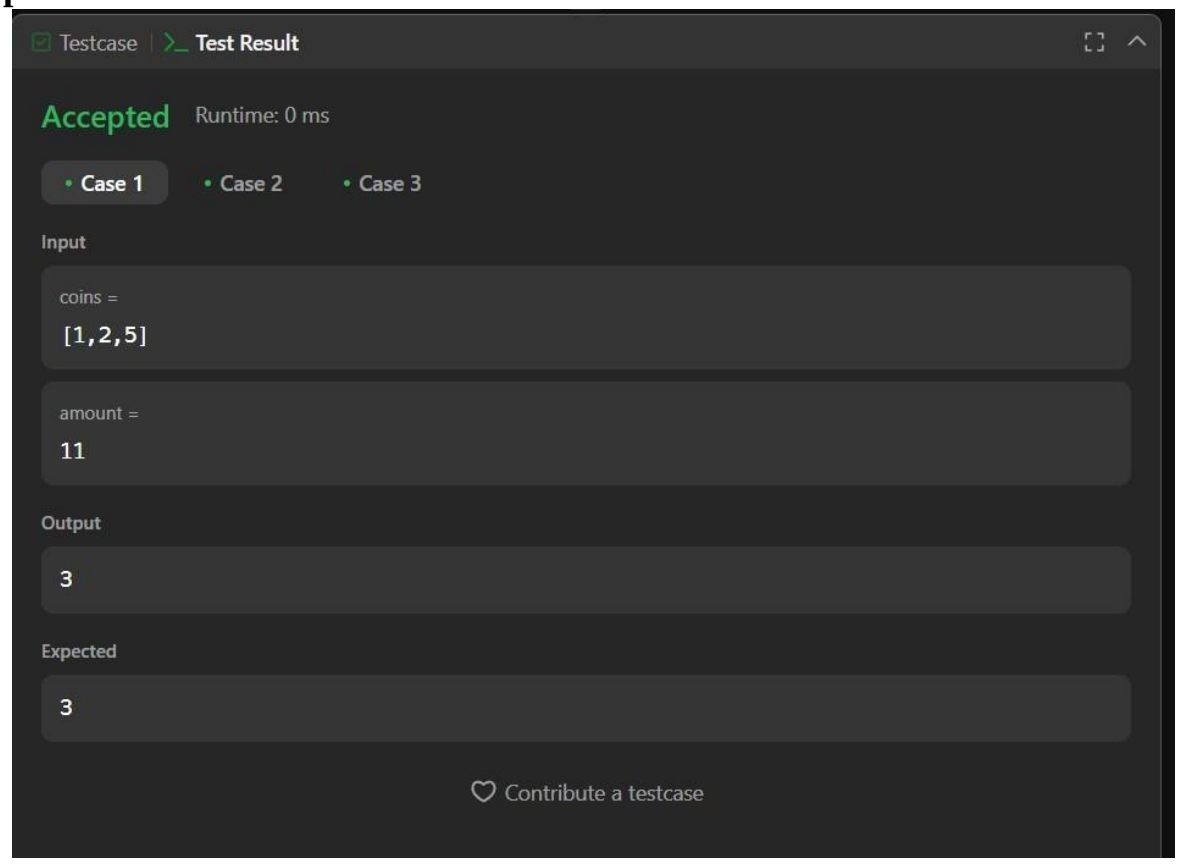
Aim- Given a list of coins with different denominations and an integer amount, find the fewest number of coins needed to make up that amount.
If it's not possible, return -1.

Code:

```
class Solution
{ public:
   int coinChange(vector<int>& coins, int amount)
      { int n=coins.size();
      int t[n+1][amount+1];
      for(int i=0;i<n+1;i++){
         for(int
            j=0;j<amount+1;j++){ if(i==
            0){
               t[i][j]=INT_MAX-1;
            }
            if(j==0){ t[i]
               [j]=0;
            }
         }
      }
      for(int
         i=1;i<amount+1;i++){ if(i%coins[0]
         ==0) t[1][i]=i/coins[0]; else
         t[1][i]=INT_MAX-1;
      }
      for(int
         i=2;i<n+1;i++){ for(in
         t
            j=1;j<amount+1;j++){ if(c
            oins[i-1]<=j){
               t[i][j]=min(1+t[i][j-coins[i-1]],t[i-1][j]);
            }
            else{
               t[i][j]=t[i-1][j];
            }
```

```
            }
        }
        if( t[n][amount]==INT_MAX-
            1){ return -1;
        }
        else{
            return t[n][amount];
        }
    }
};
```

Output:



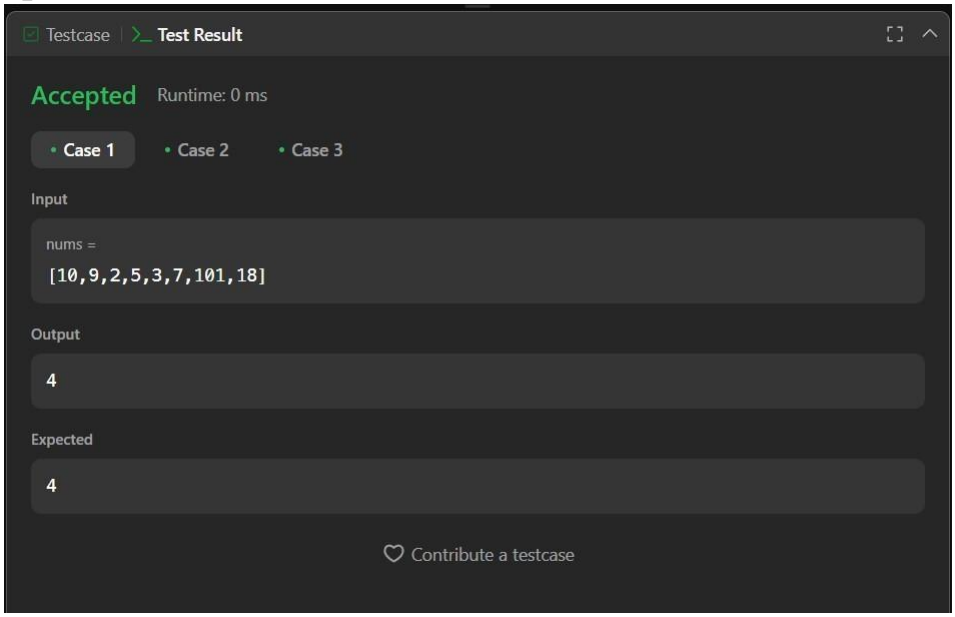
Problem 5. Longest Increasing Subsequence

Aim-Given an integer array nums, return the length of the longest increasing subsequence (LIS).A subsequence is a sequence derived from an array by deleting some or no elements without changing the order.

Code:

```
class Solution { // 256 ms, faster than 42.84%
public:
    int lengthOfLIS(vector<int>& nums)
        { int n = nums.size();
        vector<int> dp(n, 1);
        for (int i = 0; i < n; ++i)
            for (int j = 0; j < i; ++j)
                if (nums[i] > nums[j] && dp[i] < dp[j] + 1)
                    dp[i] = dp[j] + 1;
        return *max_element(dp.begin(), dp.end());
    }
};
```

Output:



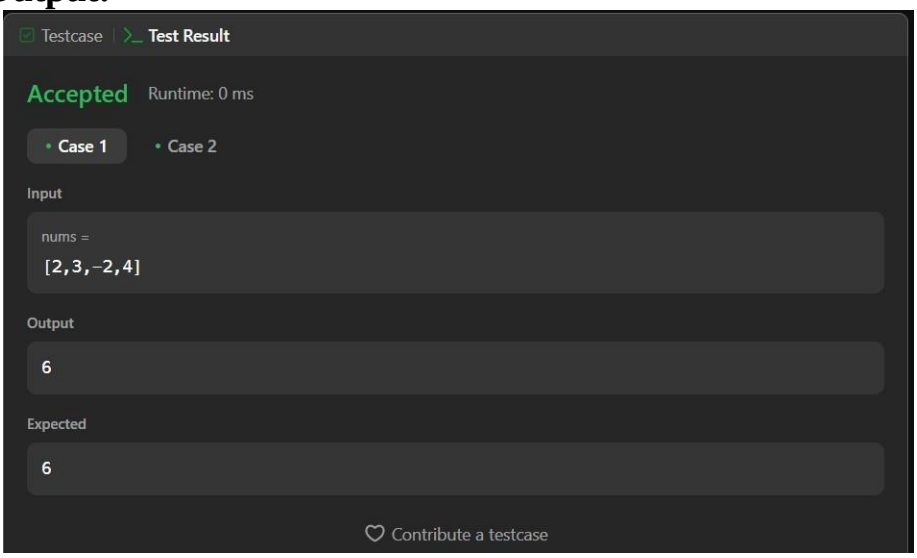
Problem 6. Maximum Product Subarray

Aim-Given an integer array nums, find the contiguous subarray (of at least one number) that has the largest product and return the product.

Code:

```
class Solution
{ public:
    int maxProduct(vector<int>& nums) {
        int res = *max_element(nums.begin(), nums.end());
        int curMax = 1, curMin = 1;

        for (int n : nums) {
            int temp = curMax * n;
            curMax = max({temp, curMin * n, n});
            curMin = min({temp, curMin * n, n});

            res = max(res, curMax);
        }

        return res;
    }
};
```

Output:



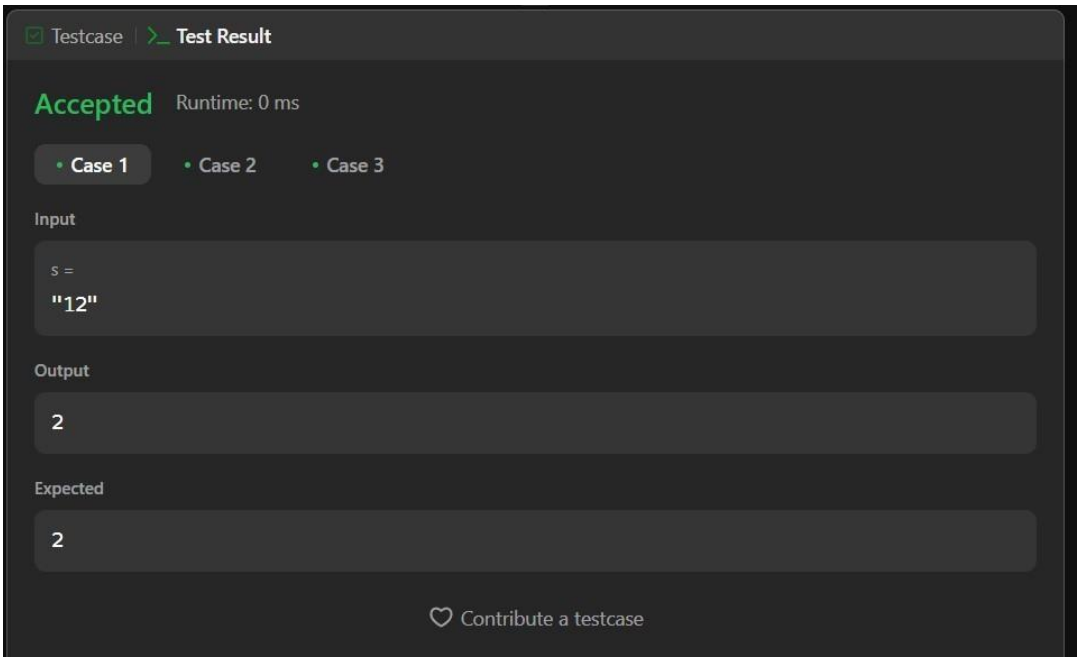
Problem 7:- Decode Ways

Aim-Given a string `s` containing digits, return the number of ways to decode it.
Each digit (1-26) maps to A-Z (`1 -> A`, `2 -> B`, ..., `26 -> Z`).

Code:

```
class Solution
{ public:
   int numDecodings(string s)
      { if (s[0] == '0') {
         return 0;
      }

      int n = s.length();
      vector<int> dp(n + 1, 0);
      dp[0] = dp[1] = 1;

       for (int i = 2; i <= n; i++)
          { int one = s[i - 1] - '0';
         int two = stoi(s.substr(i - 2, 2));

         if (1 <= one && one <= 9)
            { dp[i] += dp[i - 1];
         }
         if (10 <= two && two <= 26)
            { dp[i] += dp[i - 2];
         }
      }

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

Output:



Problem 8:-Best time to buy and Sell a Stock with Cooldown

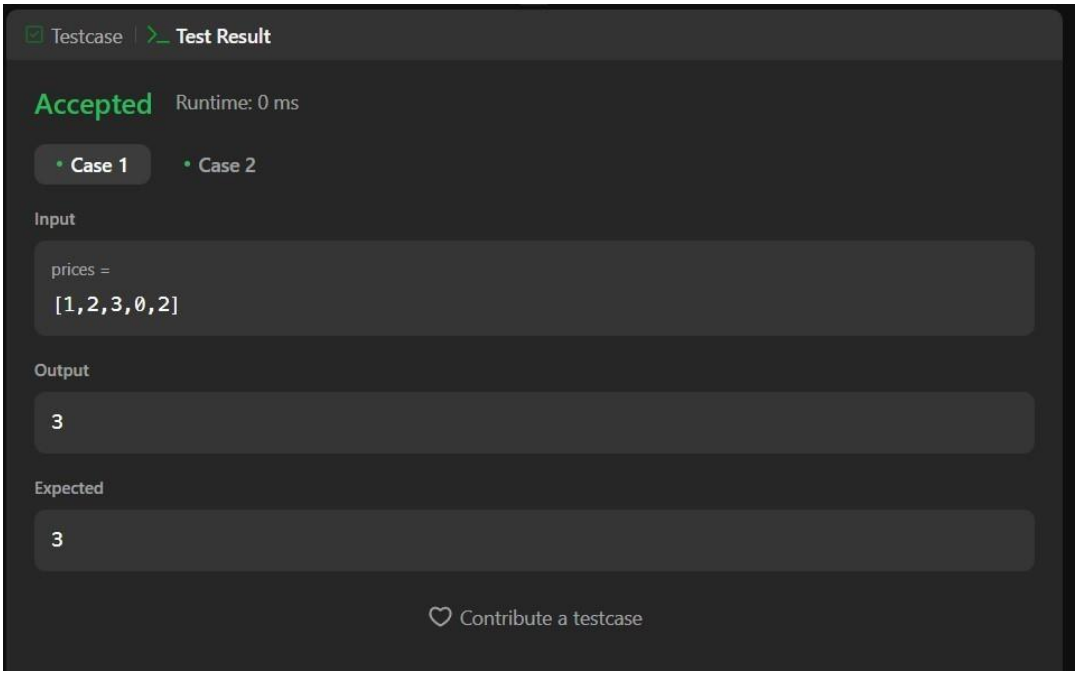
Aim-You are given an array prices where prices[i] is the price of a given stock on day i.You may buy and sell the stock multiple times, but after selling, you must wait one day (cooldown) before buying again.
Find the maximum profit you can achieve.

Code:-

```
class Solution
{ public:
   int maxProfit(vector<int>& prices) {

      int coolDown=0, sell=0, hold=std::numeric_limits<int>::min();

      for( int stockPrice_Day_i : prices){

         int prevCoolDown = coolDown, prevSell = sell, prevHold = hold;
         coolDown = max(prevCoolDown, prevSell);
         sell = prevHold + stockPrice_Day_i;
         hold = max(prevHold, prevCoolDown - stockPrice_Day_i);
```

```
            }

            return max( sell, coolDown );
        }
    }
```

Output:-



Problem 9:- Perfect Squares

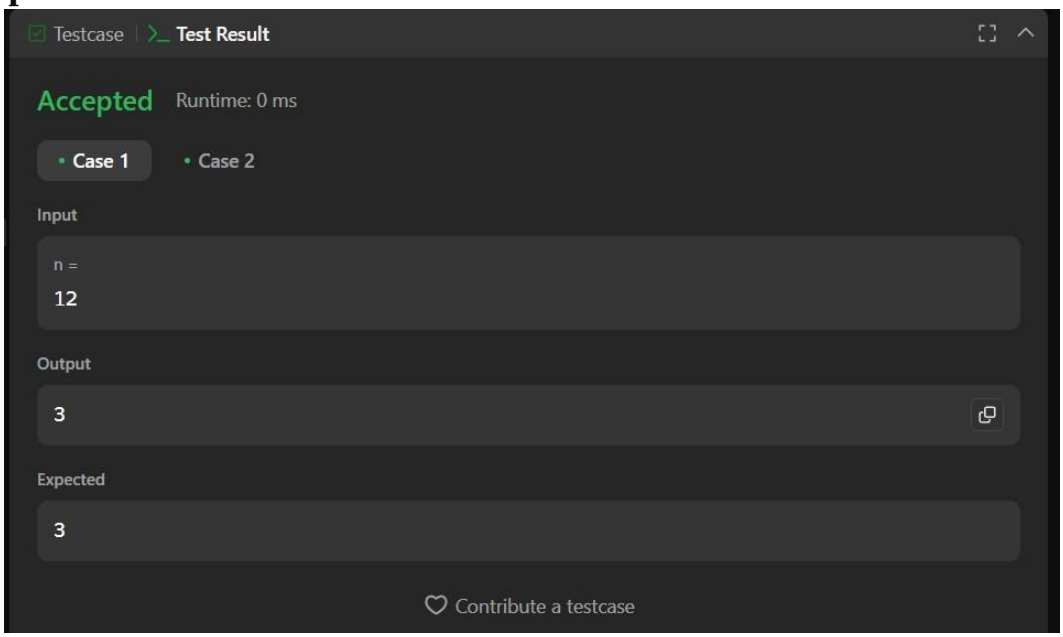
Aim- Given an integer n, return the least number of perfect square numbers (1, 4, 9, 16, ...) that sum to n.

Code:-

```
class Solution
{ public:
    int numSquares(int n) {
        vector<int> dp(n + 1, INT_MAX); dp[0]
        = 0;
        for (int i = 1; i <= n; ++i) {
            for (int j = 1; j * j <= i; ++j){
            dp[i] = min(dp[i], dp[i - j * j] + 1);
```

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

Output:-



Problem 10:- Word Break

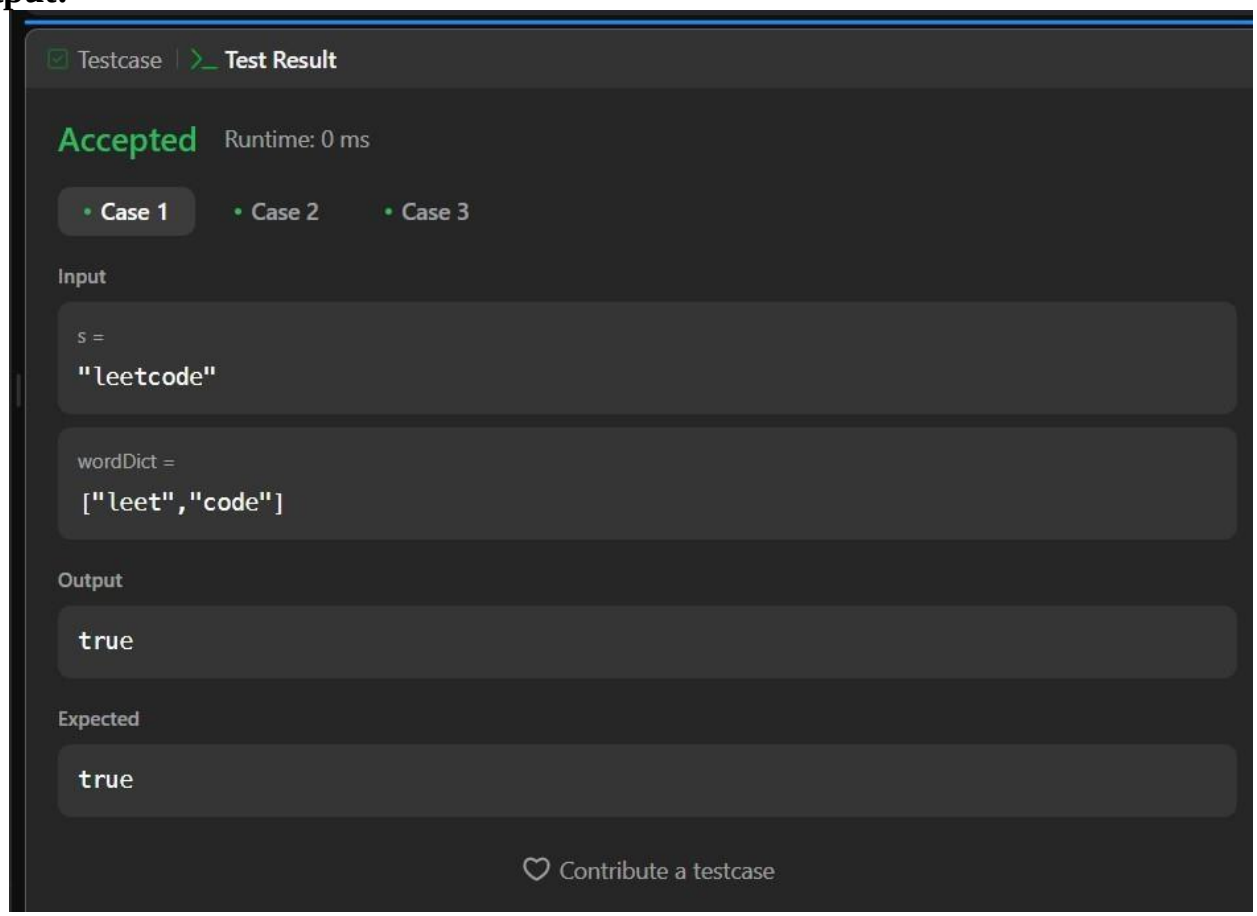
Aim-Given a string s and a dictionary of strings wordDict, return true if s can be segmented into a space-separated sequence of one or more dictionary words.

Code:-

```
class Solution
{ public:
   bool wordBreak(string s, vector<string>& wordDict)
      { vector<bool> dp(s.size() + 1, false);
      dp[0] = true;

      for (int i = 1; i <= s.size(); i++)
         { for (const string& w : wordDict)
            { int start = i - w.length();
```

```
                if (start >= 0 && dp[start] && s.substr(start, w.length()) == w)
                    { dp[i] = true;
                    break;
                }
            }
        }
        return dp[s.size()];
    }
};
```

Output:-



Problem 11:- Word Break 2

Aim - Given a string s and a dictionary of strings wordDict, add spaces in s to construct a sentence where each word is a valid dictionary word. Return all such possible sentences in any order.

Code:-

```
class Solution
{ public:
   void solve(string s, vector<string>& res, unordered_set<string>& st,
vector<string>&temp){
      if(s.length() ==
         0){ string str = "";
               for(auto
        it:temp){ str += it +
                  " ";
         }
         str.pop_back();
         res.push_back(str);
         return;
      }
      for(int          i=0;i<s.length();
         i++){   if(st.count(s.substr(0,
         i+1))){
            temp.push_back(s.substr(0, i+1));
            solve(s.substr(i+1), res, st, temp);
            temp.pop_back();
         }
      }
   }
   vector<string> wordBreak(string s, vector<string>& wordDict)
      { vector<string>res, temp;
      unordered_set<string>st(wordDict.begin(), wordDict.end());

      solve(s, res, st, temp);
      return res;
   }
};
```

Output-


Testcase
Test Result
Accepted
Runtime: 0 ms
Case 1
Case 2
Case 3
Input
s =
"catsanddog"
wordDict =
["cat","cats","and","sand","dog"]
Output
["cat sand dog","cats and dog"]
Expected
["cats and dog","cat sand dog"]
Contribute a testcase