



Experiment - 7

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Subject: AP LAB - 2

UID: 22BET10151

Section: IOT 703/A

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Subject Code: 22ITP-351

1. Aim:

Problem 1.1.1: Climbing Stairs

Problem Statement: Climbing Stairs Find the number of ways to climb n stairs when you can take 1 or 2 steps at a time. This follows the Fibonacci sequence and can be solved using dynamic programming (DP) in $O(n)$ time and $O(1)$ space. Edge cases include $n = 1$ and $n = 2$.

- 2. Objectives:** Find the number of ways to climb n stairs using 1 or 2 steps at a time. Solve efficiently using DP in $O(n)$ time and $O(1)$ space, following the Fibonacci sequence while handling edge cases like $n = 1$ and $n = 2$.

3. Implementation of Code:

```
class Solution {
public:
    int solve(int n,vector<int> &dp){
        //base case
        if(n<=2)
            return n;

        if(dp[n]!=-1)
            return dp[n];

        dp[n]=solve(n-1,dp)+solve(n-2,dp);
        return dp[n];
    }
    int climbStairs(int n) {
        if(n<=2)
            return n;
        vector<int> dp(n+1,-1);
        return solve(n,dp);
    }
};
```



4. Output:

✓ Testcase | > Test Result

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

n =
2

Output

2

Expected

2

Problem 1.1.2: Maximum Subarray

Problem Statement: - Maximum Subarray Find the contiguous subarray with the maximum sum using Kadane's Algorithm. This runs in $O(n)$ time and $O(1)$ space. Edge cases include an array of all negative numbers.

Implementation of Code:

```
class Solution {
public:
    int maxSubArray(vector<int>& nums) {
        int res = nums[0];
        int total = 0;

        for (int n : nums) {
            if (total < 0) {
                total = 0;
            }

            total += n;
            res = max(res, total);
        }
    }
};
```



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```
        return res;  
    }  
};
```

Output:

☒ 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

1. Problem 1.1.3: House Robber

Problem Statement: You are given an array representing the amount of money in each house on a street. You cannot rob two adjacent houses. Determine the maximum amount you can rob without alerting the police.

2. Implementation of Code:

```
class Solution {
public:
    int rob(vector<int>& nums) {
        int prevRob = 0;
        int maxRob = 0;

        for (int curValue : nums) {
            int temp = max(maxRob, prevRob + curValue);
            prevRob = maxRob;
            maxRob = temp;
        }

        return maxRob;
    }
};
```

3. Output:

☒ Testcase | [> Test Result](#)

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

```
nums =
[1,2,3,1]
```

Output

4

Expected

4

Problem 1.1.4: Jump Game

Problem Statement: Given an array where each element represents the maximum jump length from that position, determine if you can reach the last index starting from the first index

Implementation of code:

```
class Solution {
public:
    bool canJump(vector<int>& nums) {
        int goal = nums.size() - 1;

        for (int i = nums.size() - 2; i >= 0; i--) {
            if (i + nums[i] >= goal) {
                goal = i;
            }
        }

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

Output:

☒ Testcase | ☒ Test Result

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

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

Output

```
true
```

Expected

```
true
```

Problem 1.1.5: Unique Paths

Problem Statement: You are given an $m \times n$ grid where a robot starts at the top-left and can only move right or down. Determine the number of unique paths the robot can take to reach the bottom-right corner.

Implementation of code:

```
class Solution {
public:
    int uniquePaths(int m, int n) {
        std::vector<int> aboveRow(n, 1);

        for (int row = 1; row < m; row++) {
            std::vector<int> currentRow(n, 1);
            for (int col = 1; col < n; col++) {
                currentRow[col] = currentRow[col - 1] + aboveRow[col];
            }
            aboveRow = currentRow;
        }

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

Output:

☒ Testcase | [> Test Result](#)

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

m =
3

n =
7

Output

28

Expected

28

Problem 1.1.6: Coin Change

Problem Statement: Given an array of coin denominations and an amount, determine the minimum number of coins needed to make up that amount. If it is impossible, return -1.

Implementation of Code:

```
class Solution {
public:
    int minCoin(vector<int> &coins, int amount) {
        if (amount <= 0) {
            return 0;
        }

        int ans = INT_MAX;
        for (int i = 0; i < coins.size(); i++) {
            int coin = coins[i];
            if (coin <= amount) {
                int recAns = minCoin(coins, amount - coin);

                if (recAns != INT_MAX) {
                    recAns += 1;
                    ans = min(ans, recAns);
                }
            }
        }
        return ans;
    }

    int coinChange(vector<int>& coins, int amount) {
        int ans = minCoin(coins, amount);
        if (ans == INT_MAX) {
            return -1;
        }
        return ans;
    }
};
```



Output:

☒ Testcase | [Test Result](#)

Accepted Runtime: 0 ms

- Case 1
- Case 2
- Case 3

Input

coins =
[1,2,5]

amount =
11

Output

3

Expected

3

Problem 1.1.7: Longest Increasing Subsequence

Problem Statement: Given an array of integers, find the length of the longest subsequence where the elements are strictly increasing.

Implementation of Code:

```
class Solution {
public:
    int LISRec(vector<int> &nums, int prev, int curr) {
        if (curr >= nums.size()) {
            return 0;
        }

        int include = 0;
        if (prev == -1 || nums[prev] < nums[curr]) {
            include = 1 + LISRec(nums, curr, curr + 1);
        }
        int exclude = LISRec(nums, prev, curr + 1);
        return max(include, exclude);
    }
};
```



```
}

int lengthOfLIS(vector<int>& nums) {
    int prev = -1;
    int curr = 0;
    return LISRec(nums, prev, curr);
}
};
```

Output:**Problem 1.1.8: Maximum Product Subarray**

Problem Statement: Given an array of integers, find the contiguous subarray (of at least one element) that has the largest product and return its product.

Implementation of Code:

```
class Solution {
public:
    int maxProduct(vector<int>& nums) {
        int maxi = INT_MIN;
        int prod=1;

        for(int i=0;i<nums.size();i++)
        {
            prod*=nums[i];
            maxi=max(prod,maxi);
            if(prod==0)
                prod=1;
        }
        prod=1;
        for(int i=nums.size()-1;i>=0;i--)
        {
            prod*=nums[i];

            maxi=max(prod,maxi);
            if(prod==0)
                prod=1;
        }
        return maxi;
    }
};
```



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Output:

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Accepted Runtime: 0 ms

- Case 1
- Case 2

Input

nums =
[2,3,-2,4]

Output

6

Expected

6

Learning Outcomes:

- Understand how to solve problems using dynamic programming by breaking them into smaller subproblems.
- Learn to optimize time and space complexity using DP techniques.
- Recognize how the Fibonacci sequence applies to real-world problems like climbing stairs.
- Understand how to handle constraints (e.g., not robbing adjacent houses) while maximizing a value.
- Learn to solve problems like the Jump Game using greedy approaches to determine reachability.



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