DYNAMIC PROGRAMMING

AIM:

Playing with Numbers

ALGORITHM:

1. Read integer `n` (the target number).
2. Define function `ways(n)`:
   - Create array `dp` of size `n + 1`.
   - Set `dp = 1` (base case).
   - Initialize all other elements in `dp` to 0.
   - For each index `i` from `1` to `n`:Update
   - Return `dp[n]`.
3. In `main()`:
   - Read integer `n`.
   - Call `ways(n)` and store the result.
   - Print the result.

PROBLEM:

Playing with Numbers:

Ram and Sita are playing with numbers by giving puzzles to each other. Now it was Ram term, so he gave Sita a positive integer 'n' and two numbers 1 and 3. He asked her to find the possible ways by which the number n can be represented using 1 and 3.Write any efficient algorithm to find the possible ways.

Example 1:

Input: 6
Output:6
Explanation: There are 6 ways to 6 represent number with 1 and 3

1+1+1+1+1+1
3+3
1+1+1+3
1+1+3+1
1+3+1+1
3+1+1+1

Input Format
First Line contains the number n

Output Format

Print: The number of possible ways ‘n’ can be represented using 1 and 3

Sample Input

6

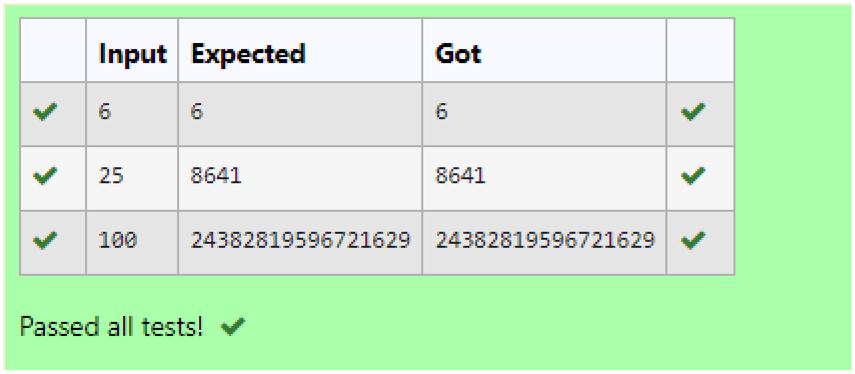
Sample Output

6

PROGRAM:

```
#include <stdio.h>


long long ways(int n) {

    long long dp[n + 1];

    dp[0] = 1;

    for (int i = 1; i <= n; i++) {

        dp[i] = 0;

    }



    for (int i = 1; i <= n; i++) {

        dp[i] += dp[i - 1];

        if (i >= 3) {

            dp[i] += dp[i - 3];
        }
    }

    return dp[n];
}

int main() {
    int n;
    scanf("%d", &n);
    long long result = ways(n);
    printf("%lld\n", result);

    return 0;
}
```

OUTPUT:



	Input	Expected	Got	
✓	6	6	6	✓
✓	25	8641	8641	✓
✓	100	24382819596721629	24382819596721629	✓

Passed all tests! ✓

AIM:

Playing with Chessboard

ALGORITHM:

1. Read integer `n` (size of the chessboard).
2. Create a 2D array `board[n][n]`.
3. Fill `board` with user input.
4. Define function `path(n, board)`:
    - Create a 2D array `dp[n][n]`.
    - Set `dp = board`.
    - For each column `j` from `1` to `n-1`:Set
    - For each row `i` from `1` to `n-1`:Set
    - For each cell `(i, j)` from `(1, 1)` to `(n-1, n-1)`:Set
    - Return `dp[n-1][n-1]`.
5. In `main()`:
    - Call `path(n, board)` and store the result.
    - Print the result.

PROBLEM:

Playing with Chessboard:

Ram is given with an n*n chessboard with each cell with a monetary value. Ram stands at the (0,0), that the position of the top left white rook. He is been given a task to reach the bottom right black rook position (n-1, n-1) constrained that he needs to reach the position by traveling the maximum monetary path under the condition that he can only travel one step right or one step down the board. Help ram to achieve it by providing an efficient DP algorithm.

Example:

Input

```
3
1 2 4
2 3 4
8 7 1
```

Output:

```
19
```

Explanation:
Totally there will be 6 paths among that the optimal is
Optimal path value:1+2+8+7+1=19

Input Format
First Line contains the integer n
The next n lines contain the n*n chessboard values

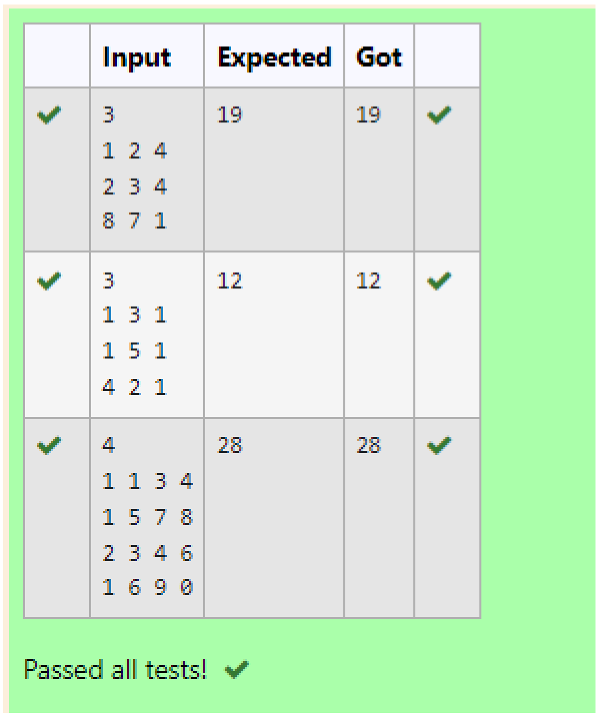
Output Format

Print Maximum monetary value of the path

PROGRAM:

```
#include <stdio.h>


int path(int n, int board[n][n]) {
    int dp[n][n];
    dp[0][0] = board[0][0];


    for (int j = 1; j < n; j++) {
        dp[0][j] = dp[0][j - 1] + board[0][j];
    }


    for (int i = 1; i < n; i++) {
        dp[i][0] = dp[i - 1][0] + board[i][0];
    }
    for (int i = 1; i < n; i++) {
        for (int j = 1; j < n; j++) {
            dp[i][j] = board[i][j] + (dp[i - 1][j] > dp[i][j - 1] ? dp[i - 1][j] : dp[i][j - 1]);
        }
    }

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

int main() {
    int n;
    scanf("%d", &n);
    int board[n][n];
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n; j++) {
            scanf("%d", &board[i][j]);
        }
    }

    int result = path(n, board);
    printf("%d\n", result);

    return 0;
}
```

OUTPUT:



	Input	Expected	Got	
✓	3 1 2 4 2 3 4 8 7 1	19	19	✓
✓	3 1 3 1 1 5 1 4 2 1	12	12	✓
✓	4 1 1 3 4 1 5 7 8 2 3 4 6 1 6 9 0	28	28	✓

Passed all tests! ✓

AIM:

Given two strings find the length of the common longest subsequence(need not be contiguous) between the two.

ALGORITHM:

1. Read two strings `s1` and `s2`.
2. Define function `common(s1, s2)`:
    - Get lengths `m` and `n` of `s1` and `s2`.
    - Create a 2D array `dp[m + 1][n + 1]`.
    - For each index `i` from `0` to `m`:For each index
    - Return the value of `dp[m][n]`.
3. In `main()`:
    - Call `common(s1, s2)` and store the result.
    - Print the result.

PROBLEM:

Given two strings find the length of the common longest subsequence(need not be contiguous) between the two.

Example:

s1: ggtabe

s2: tgatasb

s1	a	g	g	t	a	b	
s2	g	x	t	x	a	y	b

The length is 4

Solveing it using Dynamic Programming

For example:

Input	Result

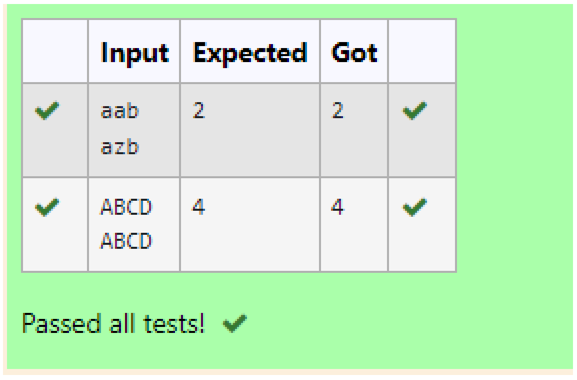
aab azb	2

PROGRAM:

```
#include <stdio.h>
#include <string.h>

int common(char *s1, char *s2) {
   int m = strlen(s1);
   int n = strlen(s2);
   int dp[m + 1][n + 1];

   for (int i = 0; i <= m; i++) {
      for (int j = 0; j <= n; j++) {
         if (i == 0 || j == 0) {
            dp[i][j] = 0;
         }
         else if (s1[i - 1] == s2[j - 1]) {
            dp[i][j] = dp[i - 1][j - 1] + 1;
         }
         else {
            dp[i][j] = (dp[i - 1][j] > dp[i][j - 1]) ? dp[i - 1][j] : dp[i][j - 1];
         }
```

```
        }
    }

    return dp[m][n];
}

int main() {
    char s1[100], s2[100];
    scanf("%s", s1);
    scanf("%s", s2);
    int result = common(s1, s2);
    printf("%d\n", result);

    return 0;
}
```

OUTPUT:



	Input	Expected	Got	
✓	aab azb	2	2	✓
✓	ABCD ABCD	4	4	✓

Passed all tests! ✓

AIM:

Find the length of the Longest Non-decreasing Subsequence in a given Sequence.

ALGORITHM:

1. Read integer `n` (size of the array).
2. Create array `arr` of size `n`.
3. Fill `arr` with user input.
4. Define function `dec(arr, n)`:
    - Create array `dp` of size `n`.
    - Initialize all elements of `dp` to 1.
    - For each index `i` from `1` to `n-1`:For each index
    - Initialize variable `maxLength = 0`.
    - For each index `i` from `0` to `n-1`:If
    - Return `maxLength`.
5. In `main()`:
    - Call `dec(arr, n)` and store the result.
    - Print the result.

PROBLEM:

Problem statement:

Find the length of the Longest Non-decreasing Subsequence in a given Sequence.

Eg:

Input:9

Sequence:[-1,3,4,5,2,2,2,2,3]

the subsequence is [-1,2,2,2,2,3]

Output:6

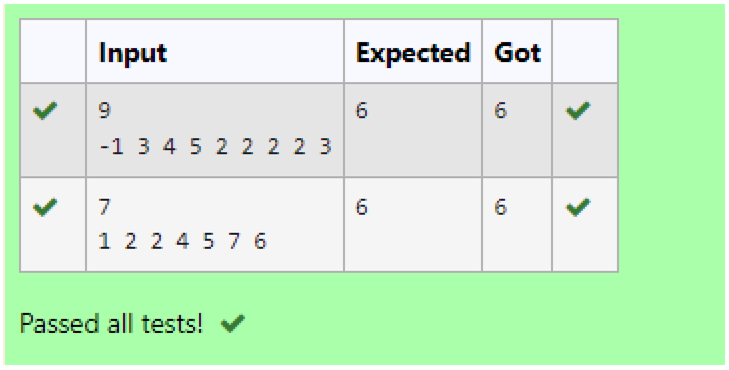
PROGRAM:

```
#include <stdio.h>
```

```
int dec(int arr[], int n) {
    int dp[n];
    for (int i = 0; i < n; i++) {
        dp[i] = 1;
    }

    for (int i = 1; i < n; i++) {
        for (int j = 0; j < i; j++) {
            if (arr[j] <= arr[i]) {
                dp[i] = (dp[i] > dp[j] + 1) ? dp[i] : (dp[j] + 1);
            }
        }
    }

    int maxLength = 0;
    for (int i = 0; i < n; i++) {
        if (dp[i] > maxLength) {
            maxLength = dp[i];
        }
    }

    return maxLength;
}
```

```
int main() {
    int n;
    scanf("%d", &n);
    int arr[n];
    for (int i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }

    int result = dec(arr, n);
    printf("%d\n", result);

    return 0;
}
```

OUTPUT:



	Input	Expected	Got	
✓	9 -1 3 4 5 2 2 2 2 3	6	6	✓
✓	7 1 2 2 4 5 7 6	6	6	✓

Passed all tests! ✓