**RAJALAKSHMI ENGINEERING COLLEGE**

**RAJALAKSHMI NAGAR, THANDALAM – 602 105**

A logo for a college

Description automatically generated

|  |
| --- |
| **CS23331**  **DESIGN AND ANALYSIS OF ALGORITHM LAB** |
| **Laboratory Observation Note Book** |

A white paper with black dots and blue lines

Description automatically generated with medium confidence

2024-2025

3rd Semester

231501037

DHARSHINI S

2nd Year/ AIML / A

**WEEK 05**

**DYNAMIC PROGRAMMING**

**1) 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**

**CODE:**

#include <stdio.h>

#include <stdlib.h>

long long countWays(int n) {

if (n < 0) return 0;

if (n == 0) return 1;

long long \*dp = (long long\*)calloc(n + 1, sizeof(long long));

dp[0] = 1;

dp[1] = 1;

dp[2] = 1;

for (int i = 3; i <= n; i++) {

dp[i] = dp[i-1] + dp[i-3];

}

long long result = dp[n];

free(dp);

return result;

}

int main() {

int n;

scanf("%d", &n);

long long ways = countWays(n);

printf("%lld\n", ways);

return 0;

}

**OUTPUT:**

**A screenshot of a computer

Description automatically generated**

**2) 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**

**CODE:**

#include <stdio.h>

#include <stdlib.h>

int max(int a, int b) {

return (a > b) ? a : b;

}

int findMaxPath(int n, int \*\*board) {

int \*\*dp = (int \*\*)malloc(n \* sizeof(int \*));

for (int i = 0; i < n; i++) {

dp[i] = (int \*)malloc(n \* sizeof(int));

}

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] = max(dp[i-1][j], dp[i][j-1]) + board[i][j];

}

}

int result = dp[n-1][n-1];

for (int i = 0; i < n; i++) {

free(dp[i]);

}

free(dp);

return result;

}

int main() {

int n;

scanf("%d", &n);

int \*\*board = (int \*\*)malloc(n \* sizeof(int \*));

for (int i = 0; i < n; i++) {

board[i] = (int \*)malloc(n \* sizeof(int));

for (int j = 0; j < n; j++) {

scanf("%d", &board[i][j]);

}

}

int maxPath = findMaxPath(n, board);

printf("%d\n", maxPath);

// Free the board array

for (int i = 0; i < n; i++) {

free(board[i]);

}

free(board);

return 0;

}

**OUTPUT:**

**A green and white rectangle

Description automatically generated**

**3)** **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**

**Solving it using Dynamic Programming**

**For example:**

| Input | Result |
| --- | --- |
| aab  azb | 2 |

**CODE:**

#include <stdio.h>

#include <string.h>

int lcs(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; // LCS of any string with an empty string is 0

}

else if (s1[i-1] == s2[j-1]) {

dp[i][j] = dp[i-1][j-1] + 1; // Characters match

}

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 %s", s1, s2);

int result = lcs(s1, s2);

printf("%d\n", result);

return 0;

}

**OUTPUT:**

**A green and white rectangle

Description automatically generated**

**4)** **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**

**CODE:**

#include<stdio.h>

int main()

{

int n,i,j;

scanf("%d",&n);

int a[n];

for(i=0;i<n;i++)

scanf("%d",&a[i]);

int b[n];

for(i=0;i<n;i++)

b[i]=1;

int max=1;

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

for (j = 0; j < i; j++) {

if (a[j] <= a[i]) {

b[i] = b[i] > (b[j] + 1) ? b[i] : (b[j] + 1);

}

}

if(b[i]>max)

max=b[i];

}

printf("%d",max);

}

**OUTPUT:**

**A green and white rectangle

Description automatically generated**