Question 1

There are 2n students lined up into two rows of the same size (there are exactly n people in each row). Students are numbered from 1 to n in each row in order from left to right. You need to choose a team to play basketball. You can only chose players from left to right, and the index of each chosen player (excluding the first one taken) will be strictly greater than the index of the previously chosen player. To avoid giving preference to one of the rows, you must choose students in such a way that no consecutive chosen students belong to the same row. The first student can be chosen among all 2n students (there are no additional constraints), and a team can consist of any number of students. Given 2 arrays of heights of students of both the rows, choose students in such a way, that the total height of all chosen students is maximum possible. Return the maximum height possible.

Sample Input: 1, 4, 5

3, 7, 9

Output: 16

Explanation: 3 from row2, 4 from row1, 9 from row2 = (3 + 4 + 9) = 16

Solution

Make dp of 2 row and n column

Traverse height of n column

dp[0][i]=max(dp[0][i-1],dp[1][i-1]+h[0][i]);

dp[1][i]= max(dp[1][i-1],dp[0][i-1]+h[1][i]);

return max(dp[0][n-1],dp[1][n-1]);

Question 2

Given a 3x3 matrix, there’s a rat in the (0,0) cell and cheese in (2,2) cell. Give total number of paths possible for rat to reach the cheese given:

i. There were no restrictions on rat’s movement.

ii. Rat can only move in 2 directions: right and down

iii. What would be the answer if the matrix was of size 4x4 instead.

iv. A generalized formula for NxN matrix and for any random cell. (In terms of Permutations and Combinations - this was my hint)

Solutiion

When there are no restrictions on the rat's movement, the rat can move in 4 possible directions: right, down, left, and up. However, in a simple scenario without backtracking or obstacles, the problem is combinatorial in nature.

For the 3x3 matrix:

* To reach (2,2) from (0,0), the rat must move exactly 2 steps right and 2 steps down.
* The total number of moves the rat needs to make is 4 (2 right + 2 down).
* The number of unique sequences of these moves is the number of ways to choose 2 positions out of 4 for the right moves (the rest will be down moves).

The formula for this is the binomial coefficient: (42)=4!2!⋅2!=6\binom{4}{2} = \frac{4!}{2! \cdot 2!} = 6(24​)=2!⋅2!4!​=6

So, for a 3x3 matrix with no restrictions, the number of paths is 6.

For the 4x4 matrix:

* To reach (3,3) from (0,0), the rat must move exactly 3 steps right and 3 steps down.
* The total number of moves is 6 (3 right + 3 down).
* The number of unique sequences of these moves is: (63)=6!3!⋅3!=20\binom{6}{3} = \frac{6!}{3! \cdot 3!} = 20(36​)=3!⋅3!6!​=20

So, for a 4x4 matrix with no restrictions, the number of paths is 20.

**ii. Rat Can Only Move Right and Down**

When the rat can only move right and down, the problem simplifies to finding paths in a grid where only right and down moves are allowed. This is a classic combinatorial problem where each path is determined by a sequence of moves.

For the 3x3 matrix:

* The rat needs to make 2 moves right and 2 moves down to reach (2,2).
* Using the same logic as above, the number of unique sequences of these moves is: (42)=6\binom{4}{2} = 6(24​)=6

So, the number of paths for the 3x3 matrix with only right and down movements is 6.

For the 4x4 matrix:

* The rat needs to make 3 moves right and 3 moves down to reach (3,3).
* The number of unique sequences of these moves is: (63)=20\binom{6}{3} = 20(36​)=20

So, the number of paths for the 4x4 matrix with only right and down movements is 20.