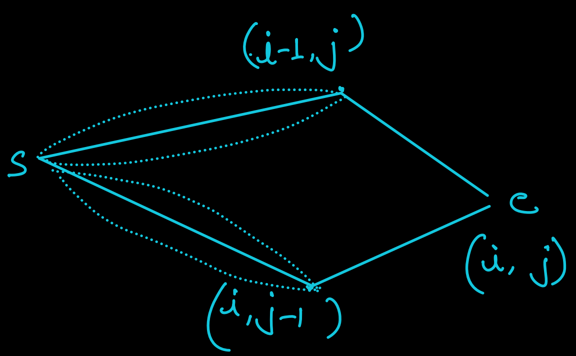
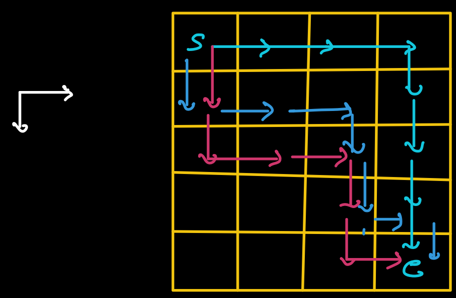
Amazon
MS
(Coding test)

Q Given a 2D matrix of size $N \times M$.
Count the no of unique paths to reach $(N-1, M-1)$ from $(0,0)$ if from any cell you can move right or down.





$$\text{Paths}(0 \text{ to } (i,j)) = \text{Paths}(0 \text{ to } (i-1,j)) + \text{Paths}(0, \text{ to } (i,j-1))$$

$$\text{paths}(i,j) = \text{Paths}(i-1,j) + \text{paths}(i,j-1);$$

$\downarrow$

No of paths from $(0,0)$ to (i,j)

Base Case

$\text{Paths}(\overset{n-1}{i}, \overset{m-1}{j}) \longrightarrow$ total paths from $(0,0)$ to $(n-1, m-1)$

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if( i<0 || j<0 )
    ret 0;

if( i==0 || j==0 )
    ret 1
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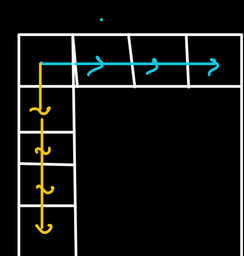
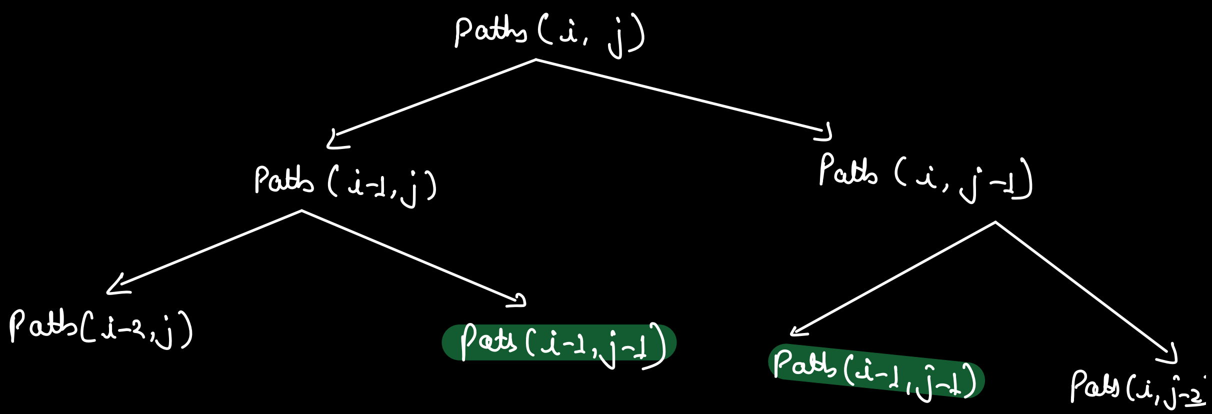




Total nodes in tree $\longrightarrow O(2^N)$

Total no of unique fn calls $\longrightarrow O(N^2)$

Recursive Code

Iterative Sol

$dp[i][j] = dp[i-1][j] + dp[i][j-1]$

ans $\longrightarrow dp[n-1][m-1]$

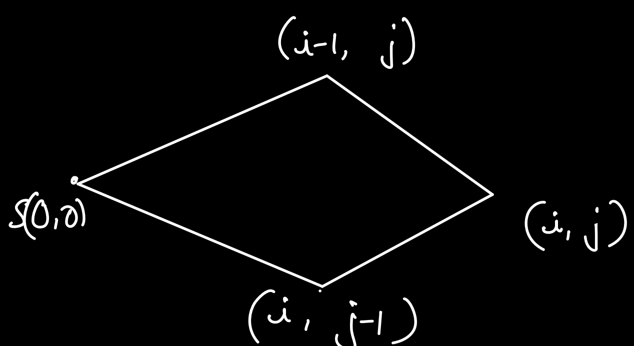
1	1	1	1
1	2	3	4
1	3	6	10
1	4	10	20
1	5	15	35
1	6	21	56

TC : $O(NM)$

SC : $O(NM) \longrightarrow O(N)/O(M)$?

Q Given a 2D grid with some values. Return the min path sum from $s(0,0)$ to $e(N-1, M-1)$

10	2	6
3	-10	70
16	5	7
1	12	6



$$minPath(i, j) = \min\begin{pmatrix} minPath(i-1, j), \\ minPath(i, j-1) \end{pmatrix} + A[i][j]$$

10	2	6
3	-10	70
16	5	7
1	12	6

A

10	12	18
13	2	72
29	7	14
30	19	20

DP

Q Given a 2D grid with some values. Return the max path sum from $S(0,0)$ to $e(N-1, M-1)$

$\rightarrow R$
$\downarrow D$

Google **Dungeon Princess**

-2	-3	3
-5	-10	1
10	30	-5

- You can move in right or down direction
- $S \longrightarrow (0,0)$
  $e \longrightarrow (N-1, M-1)$
- +ve no. increase your health &
  -ve no. reduce your health
- if at any point the health $\leq 0 \longrightarrow$ dead

Return the min amount of health with which you need to start in order to reach the princess in living state.
(ht > 0)

-2	-3	3
-5	-10	1
10	30	-5

5
6
8
13
7
22

$7 \xrightarrow{-2} 5 \xrightarrow{-3} 2 \xrightarrow{+3} 5$
$\downarrow +1$
6
$\downarrow -5$
1

1	-10	100
-10	-10	100
1	1	100

1	-100	-100
2	3	-100
4	5	-100

-2	-3	3
-5	-10	1
10	30	-5

	7	5	2
$x \rightarrow$	6	11	5
	1	1	6

x

-5

$x - 5 >= 1$

$x - 5 = 1$

$\Rightarrow x = 6$

x

1
-5

$1 + x >= 6$

$x = 5$

$x \rightarrow$

3
1
-5

$x + 3 >= 5$

$x = 2$

$x + (-10) >= 1$

$x = 11$

$x + (-5) = 1$

$x = 6$

$x + (-3) = 2$

$x = 5$

$x + (-2) = 5$

$x = 7$

$x \rightarrow$

30	-5

$x + 30 >= 6$

$x = -24$

$\hookrightarrow 0 \rightarrow$

10	30	-5

x

$x + 10 >= 1$

$x = -9 \rightarrow 1$

$$x + A[i][j] >= \min(dP[i+1][j],\ dP[i][j+1]);$$

$dP[i][j]$ = minimum amount of energy required before stepping onto (i, j) for reaching the princess alive.

$$x = \min(dP[i+1][j],\ dP[i][j+1]) - A[i][j]$$

$$x \xrightarrow{+ve} dP[i][j] = x$$

$$x \xrightarrow{-ve/0} dP[i][j] = 1$$