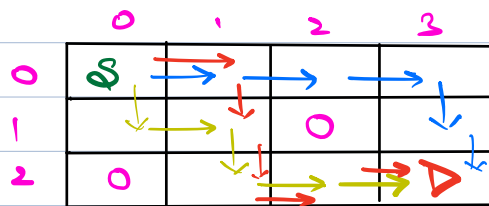


Q Given a 2D matrix of size  $N \times M$   
(Grid)  
 Count the total no. of ways / paths  
 to go from  $(0,0)$  to  $(N-1, M-1)$

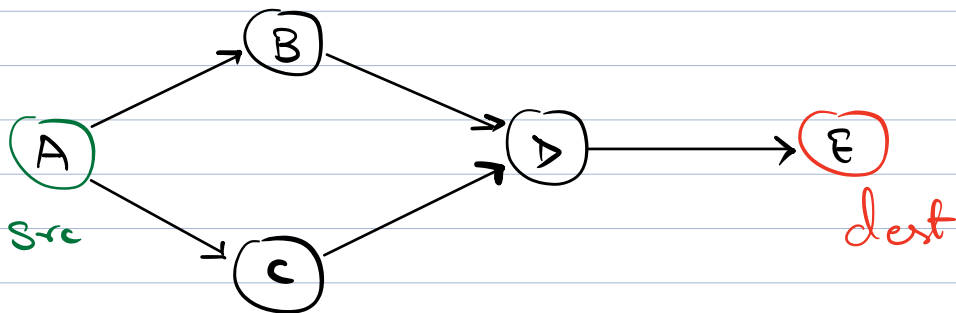
$(i, j) \rightarrow (i, j+1)$   
 $\downarrow$   
 $(i+1, j)$

Grid  $\Rightarrow M[i][j] = 0$  (closed)



Ans = 3

3x4



$$\text{ways}(A \rightarrow E) = \text{Ways}(A \rightarrow D) \times \text{Ways}(D \rightarrow E)$$

Sol<sup>n</sup>

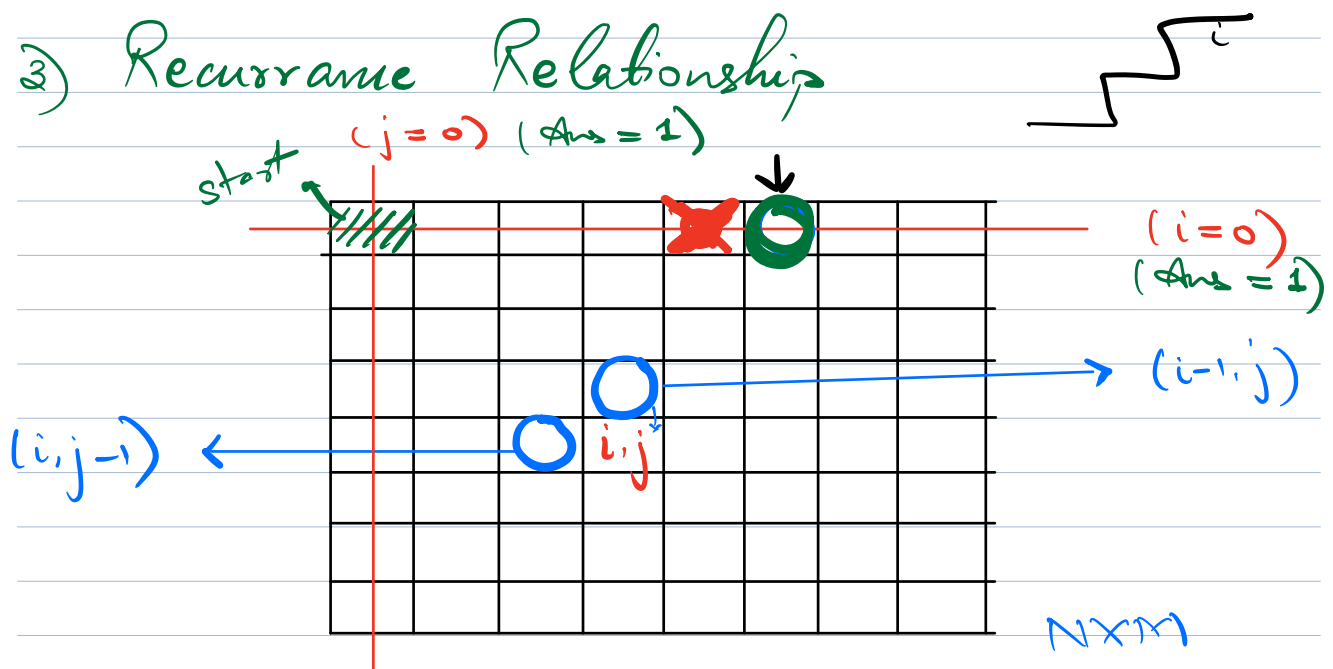
Recursion ✓

1) Element of Choice  $\Rightarrow$  Go down  $\sim$   
Go right

2) What are we calculating in a state

$Ways(i, j) =$  No. of ways to reach the cell  $(i, j)$

3) Recurrence Relationship



$Ways(i, j)$

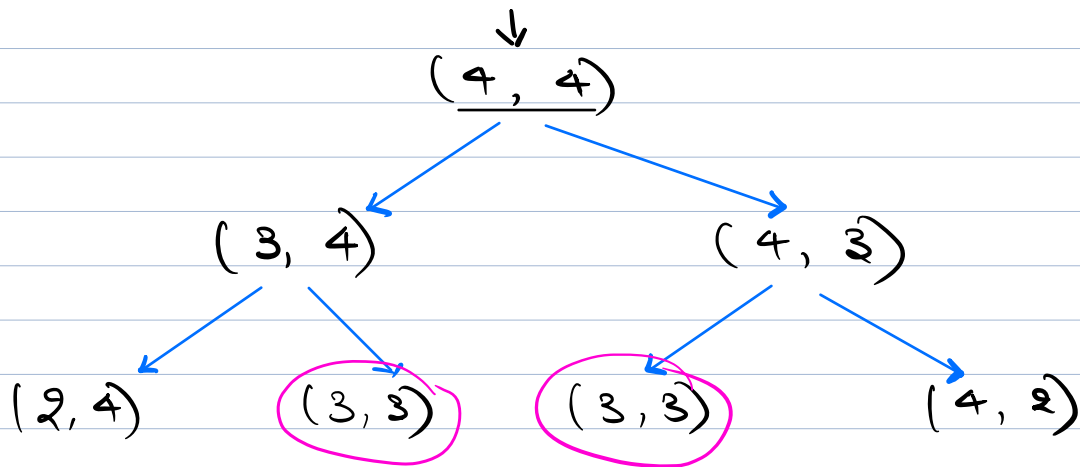
Down  $\rightarrow$   $Ways(i-1, j)$

+

Right  $\rightarrow$   $Ways(i, j-1)$

$$\text{Ways}(\overset{\downarrow}{\underset{\downarrow}{(i, j)}}) = \text{Ways}(i-1, j) + \text{Ways}(i, j-1)$$

$(N-1, M-1)$   $\leq x \leq$



$DP[N][M] \longrightarrow 2D \text{ Array}$

Base Cases

$$\text{Ways}(i, j) = \text{Ways}(i-1, j) + \text{Ways}(i, j-1)$$

$$\begin{matrix} i \rightarrow (i-1) \\ j \rightarrow (j-1) \end{matrix}$$

$$\begin{matrix} (i=0) > (i=0, j=0) \\ (j=0) > (i=0, j=0) \end{matrix}$$

Code

$$DP[N][M] = d - 1$$

```
int Ways (x, y) {
```

```
    if (x < 0 || y < 0) {
        return 0;
```

```
    if (m[x][y] == 0) {
        return 0;
```

```
    if (x == 0 && y == 0) {
        return 1;
```

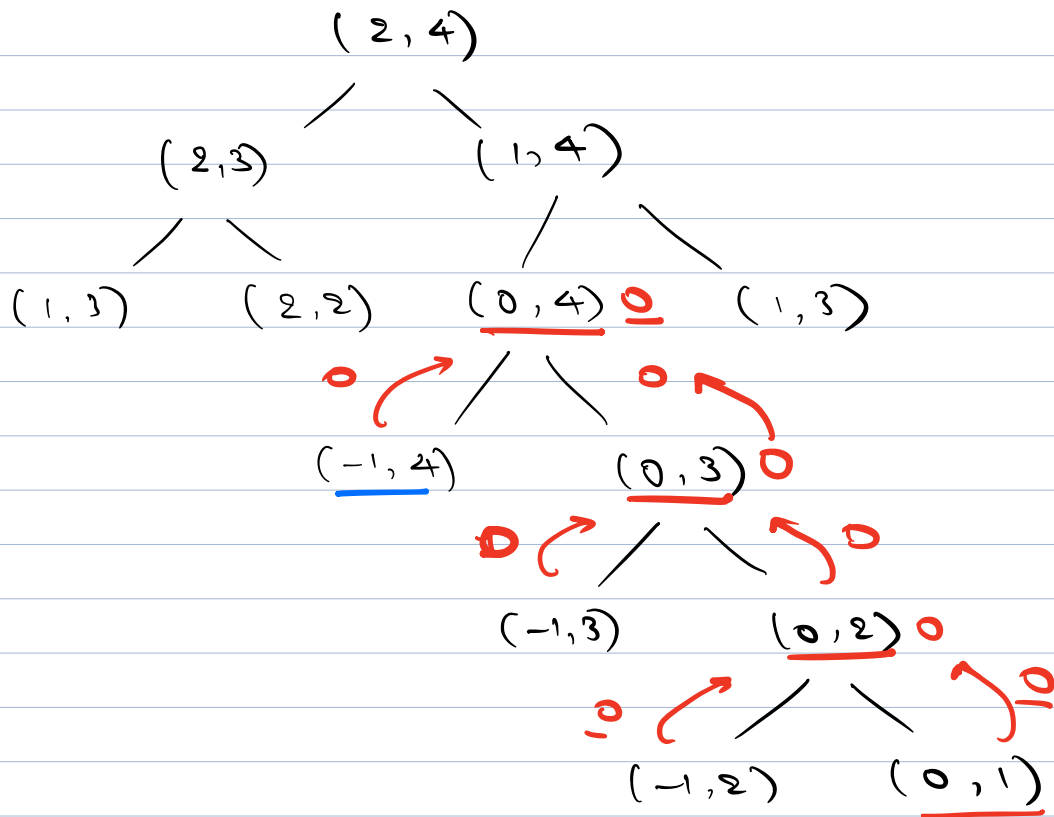
```
    if (DP[x][y] != -1) {
        return DP[x][y];
    }
```

```
    DP[x][y] = Ways(x-1, y) + Ways(x, y-1);
```

```
    return DP[x][y];
```

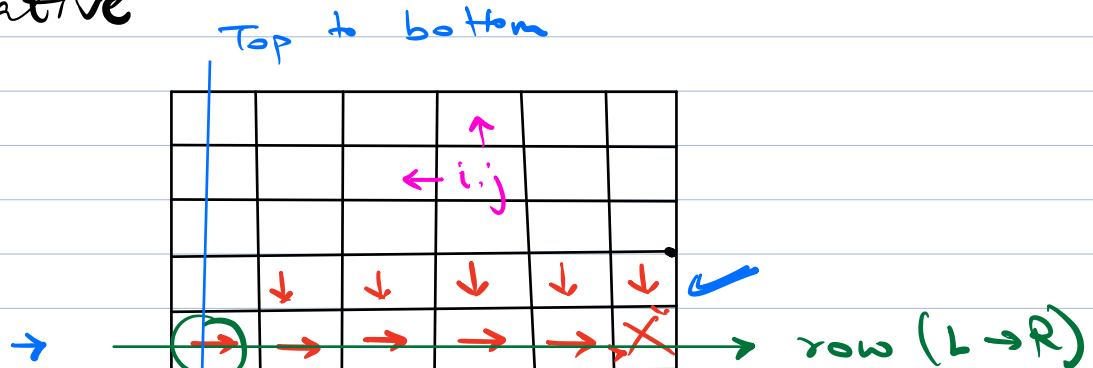
```
}
```

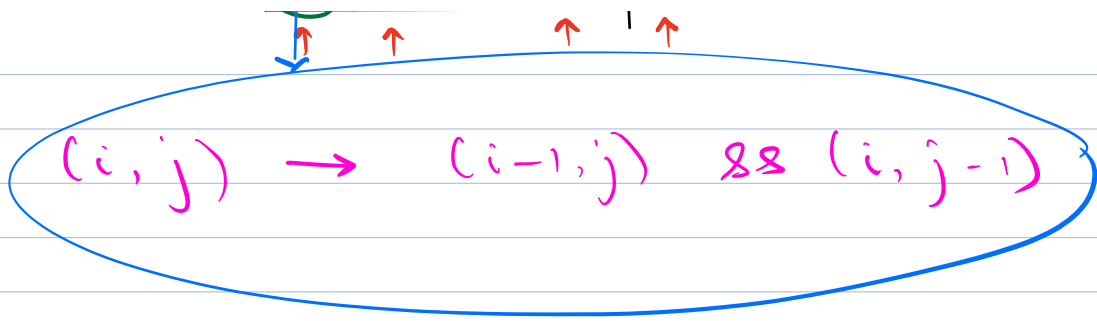
	0	1	2	3	4
0		0		x	x
1				x	x
2			x	x	x



$$\begin{aligned}
 \text{T.C.} &= \overset{\text{Unique}}{\underbrace{(\# \text{ States})}} \times (T/\text{State}) \\
 &\quad \downarrow \\
 &= O(N \times M) \times O(1) \\
 &= \underline{\underline{O(N \times M)}}
 \end{aligned}$$

Iterative

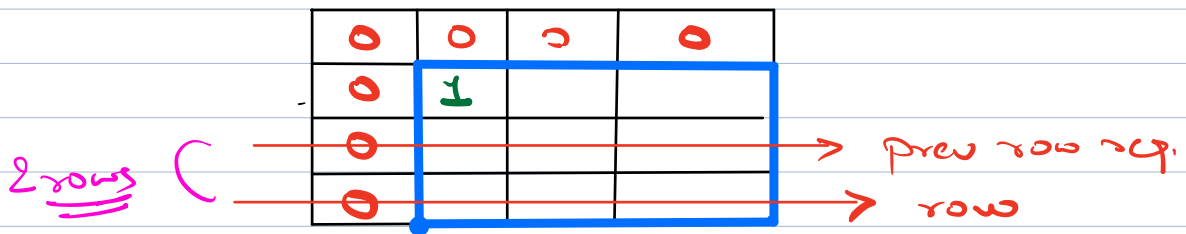




$$N \rightarrow (N+1)$$

$$N \times M \rightarrow (N+1) \times (M+1)$$

3x3



$$(N-1, M-1) \rightarrow (N, M)$$

$$\text{DP}(x, y) \rightarrow M[x-1][y-1]$$

1 Based

$$\text{DP}[N+1][M+1]$$

$$\text{for } (i=0; i \leq N; i++) \{$$

$$\text{DP}[i][0] = 0;$$

}

$$\text{for } (j=0; j \leq M; j++) \{$$

↳  $DP[0][j] = 0;$

↳  $DP[i][0] = 1;$

↳ for  $(i = 1; i \leq N; i++) \{$

↳ for  $(j = 1; j \leq M; j++) \{$

↳ if  $(i == 1 \text{ \& } j == 1) \{$   
continue;

↳ if  $(M[i-1][j-1] == 0) \{$   
↳  $DP[i][j] = 0;$

↳ else {

↳  $DP[i][j] = DP[i-1][j] +$   
↳  $DP[i][j-1]$

↳

T.C. =  $O(N \times M)$

S.C. =  $O(N \times M)$

↓  
?  
?  
?  
?  
=  $O(2 \times M)$   
=  $O(M)$   
(H.O.)

follo JP — 3

Doubt

0,0	0,1	0,2

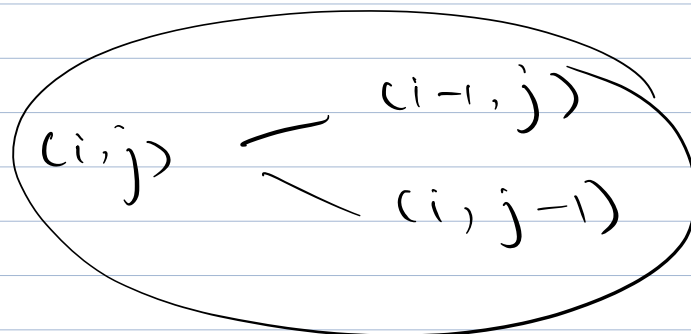
Base Case

	0	1	2	3
0	0	0	3	0
1	0	0,0	0,1	0,2
2	0	1,0	1,1	1,2
3	0	2,0	2,1	2,2

DP[0][2]

~~DP[0][2]~~

~~DP[0][1]~~



T + B  
L → R