CODING SHUTTLE

Week 3 LIVE 

Recursion Problems and Doubts Session

In This Lecture

1. Matrix Path Problem
2. Power with Modulo
3. Explain the Josephus Problem Again
4. Explain the Count occurrences Problem Again

Power with Modulo

Math.pow(3.0, 4.0)

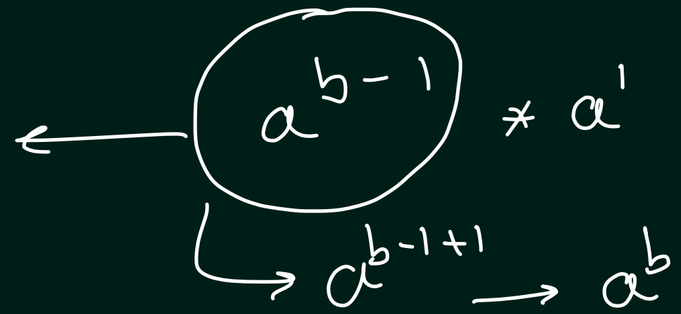
↳ $= 3^4 \rightarrow 81$

$3^4 = 3^3 * 3$

$5^4 = 5^3 * 5$

↳ Power(a, b, m)

$= a^b$



Power(a, b)

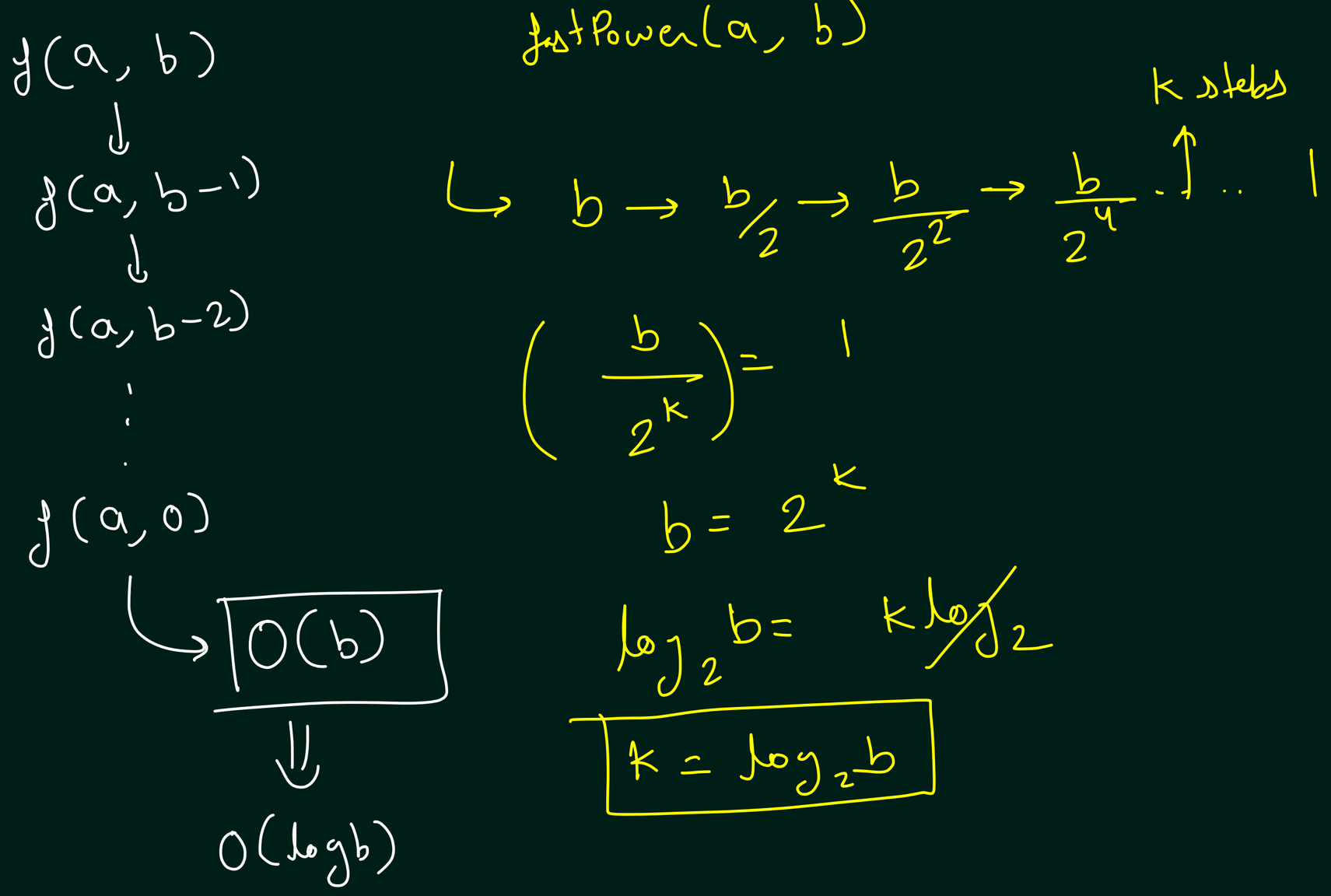
Power(a, b-1) * a

↳

b = 0

$a^0 = 1$

Power with Modulo



Power with Modulo

$\rightarrow a^b * a^c = a^{b+c}$

$\rightarrow (a^b)^c = a^{b*c}$

$\rightarrow 5^4 = (5^2)^2$

$\rightarrow 3^5 = (3) * 3^4$

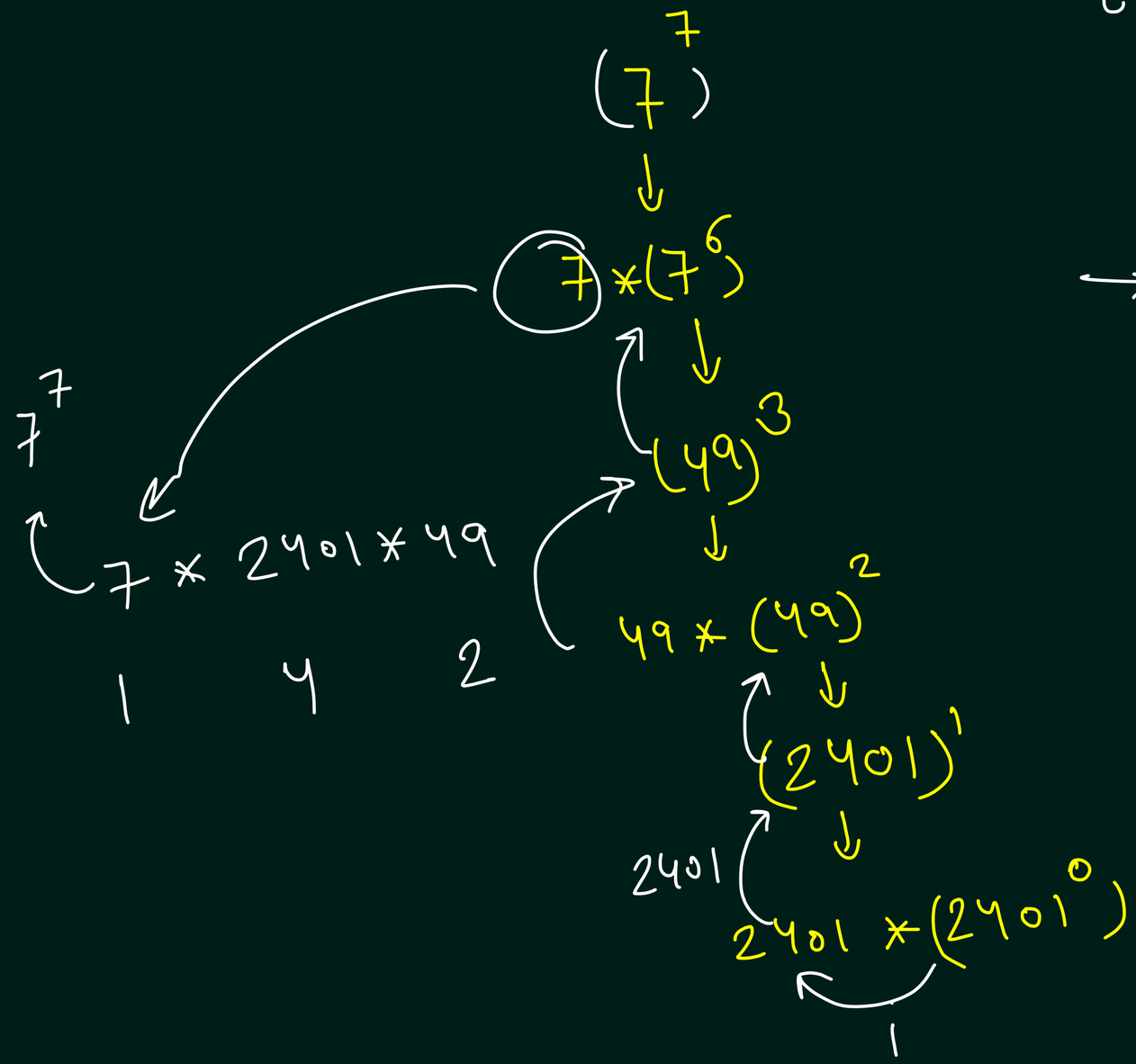
$\Rightarrow [a^b = (a^2)^{b/2}$ if b is even$]$

$7^3 = 7 * (7^2)$

$\Rightarrow [a^b = a * a^{b-1}$ if b is odd/even$]$

$5^{10} = (5^2)^5$

Power with Modulo



Even → $n \% 2 = 0$ ✓

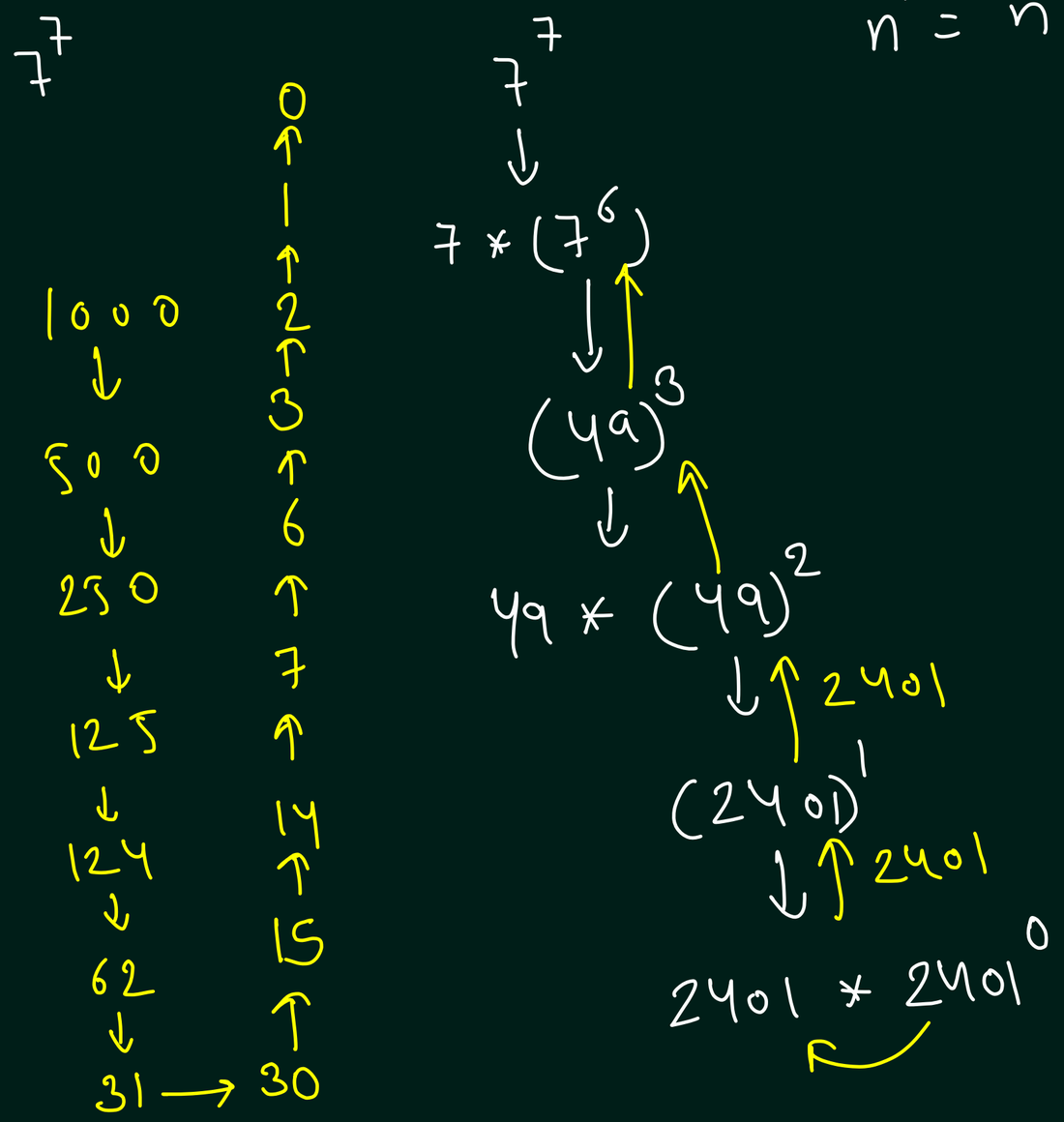
$n \& 1 = 0$ ∵ LSB is Zero

$(1\,1\,0)_2$

$\&\ 0\,0\,1$

$(0\,0\,0)_2$

Power with Modulo




```
3 usages
static double fastPower(double a, int b) {
    if(b == 0) return 1;

    if(b % 2 == 0) {
        return fastPower( a: a*a,  b: b/2);
    } else {
        return a * fastPower(a,  b: b-1);
    }
}
```

$\log_2 1000 = \log_2 10^3$

$= 3 \log_2 10$

$= 9.\ldots \rightarrow \boxed{10}$

Power with Modulo

→ $(a+b) \% m = (a \% m + b \% m) \% m$

→ $(a * b) \% m = (a \% m * b \% m) \% m$ → int

→ (0 .... m-1)

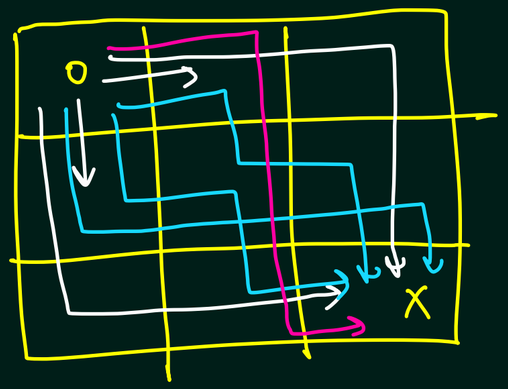
$(32^{48}) \% 30$

→ [0 ... 29]

if negative

$$a^{-b} = \left(\frac{1}{a}\right)^{b}$$

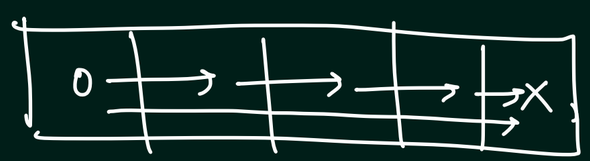
Matrix Path Problem



(N x M)

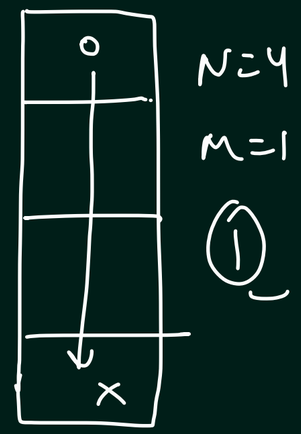
Right

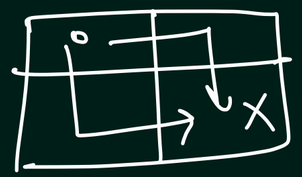
Bottom



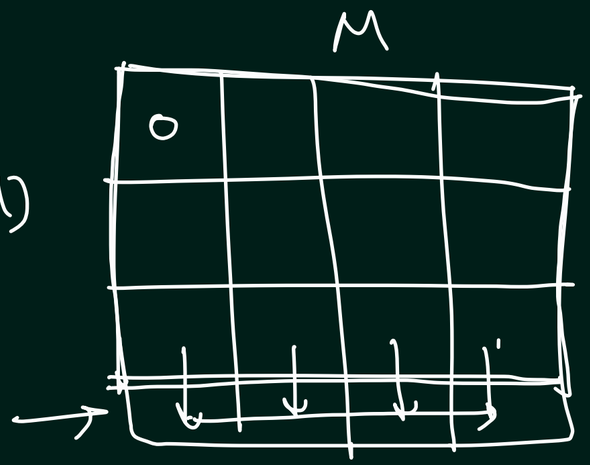
N = 1
M = 5

Path = (1)

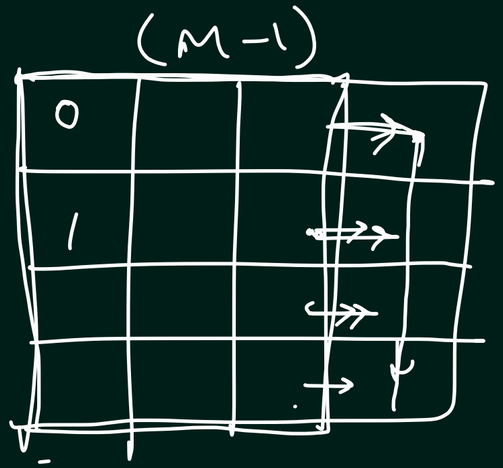




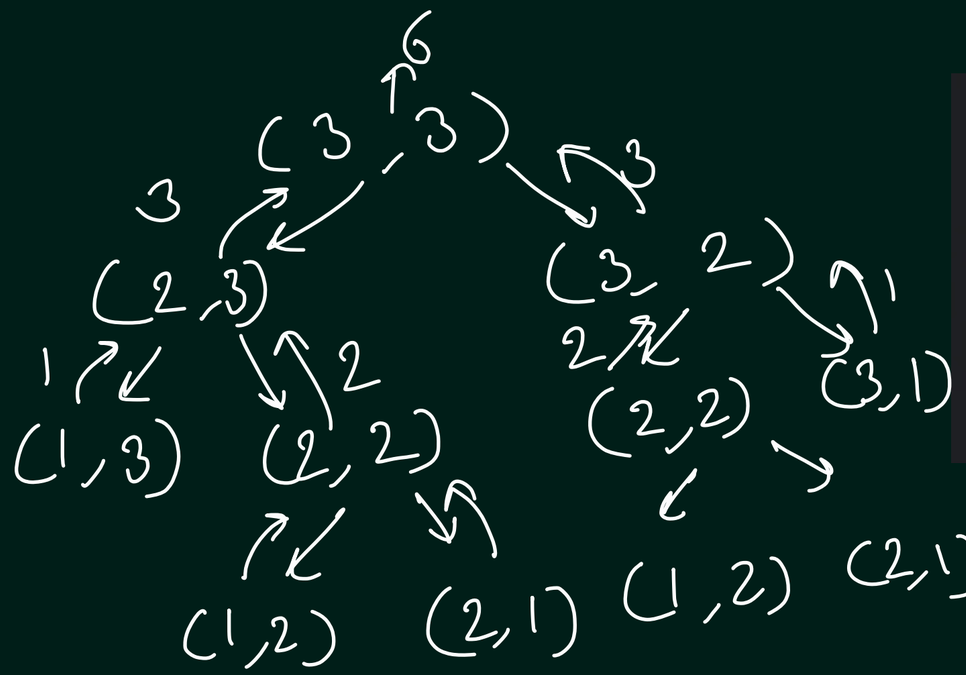
(N-1)



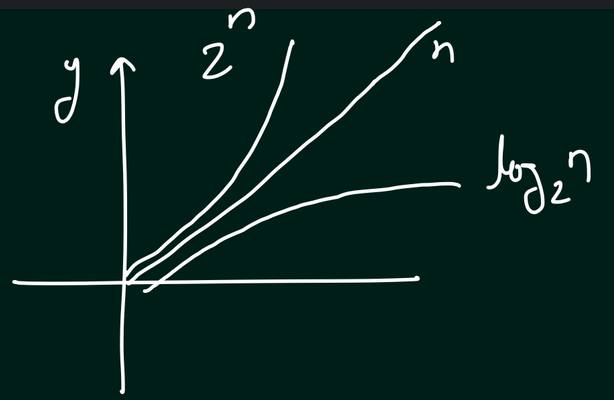
+

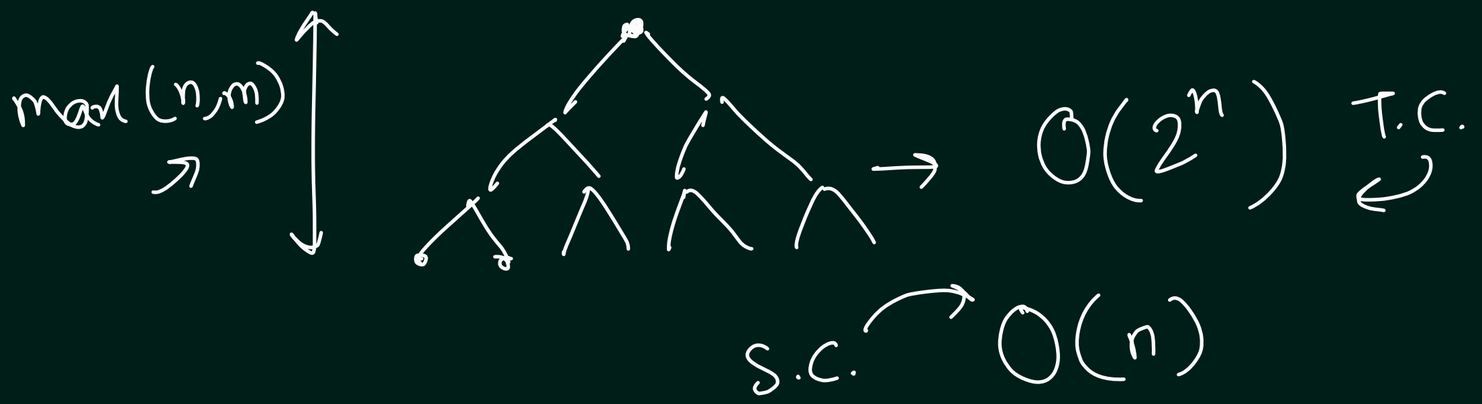


Matrix Path Problem

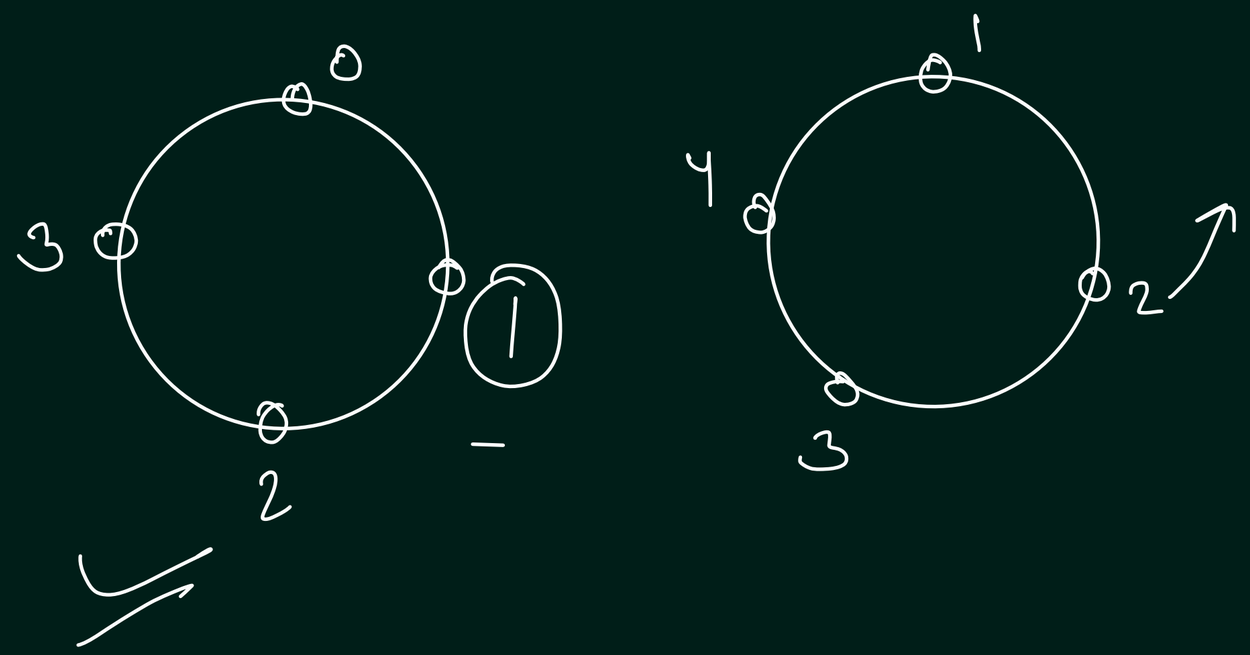


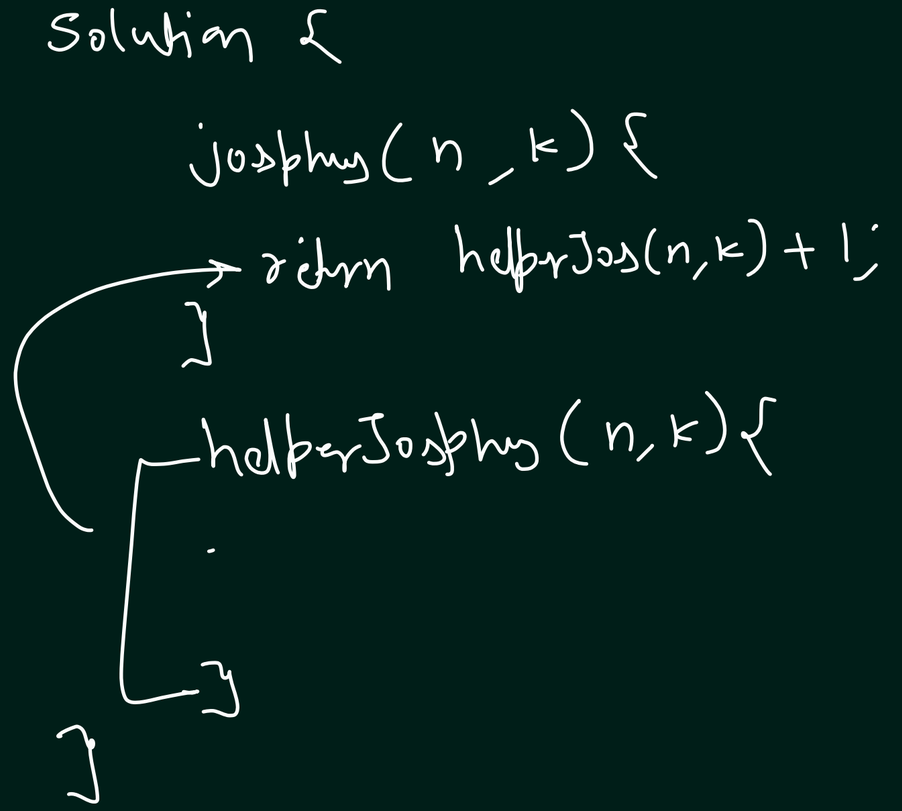

```
3 usages
static int matrixPaths(int n, int m) {
    if(n == 1 || m == 1) return 1;

    return matrixPaths( n: n-1, m) + matrixPaths(n,  m: m-1);
}
```



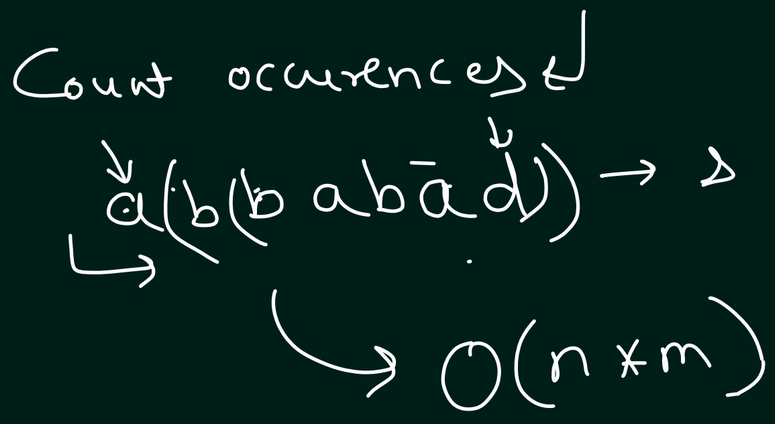


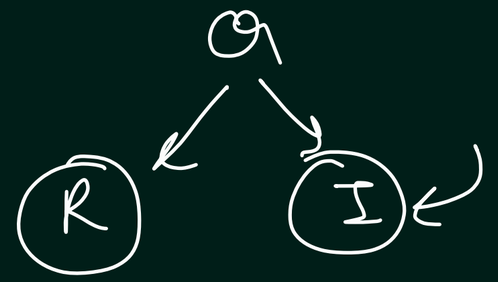
Doubts Session





Doubts Session





f(s, t, i)

f(s, t, i+1)