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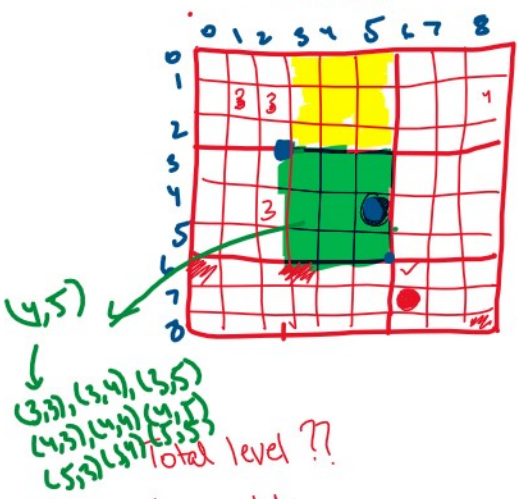
Sudoku Solver

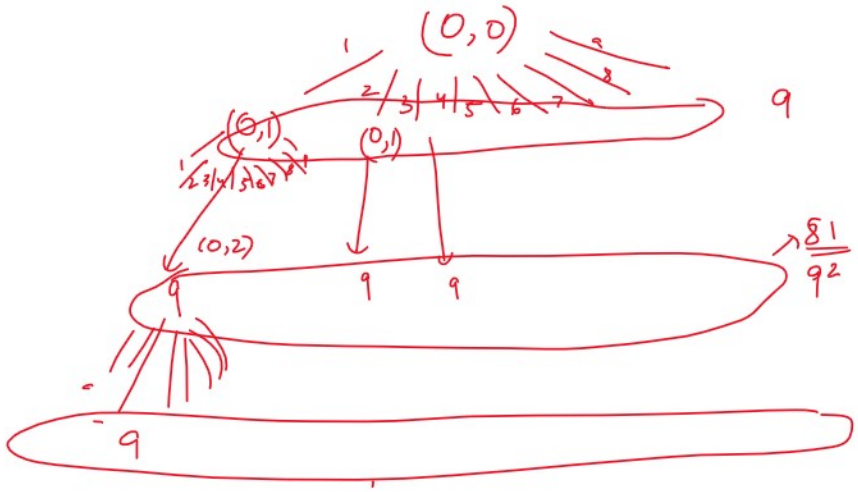


9×9

Row → 1-9
Col → 1-9
Block → 1-9

9×9

Total level ??
↳ Tree ht
↳ 81



Total

0,0	0,1	0,2	0,3	0,4
1,1	1,1	2,1	3,1	4,1
1,2		2,2	3,2	
1,3		2,3	3,3	
⋮		⋮	⋮	⋮
1,9		2,9	3,9	
		81		

(0,0)
↓ 81
(8,8)

(0,8)

(8,8)

9^{81}

$9 + 9^2 + 9^3 + \ldots + 9^{81}$

(4, 5)
(3,3) →

$4 - (4 \cdot\!/ 3) = 3$
$5 - (5 \cdot\!/ 3) = 3$

(7,6)

?? $r - (r \cdot\!/ 3) =$ $7 - (7 \cdot\!/ 3) = 6$
$c - (c \cdot\!/ 3) =$ $6 - (6 \cdot\!/ 3) = 6$

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Time complexity ??

↳ $f(n) \rightarrow g(n)$ ✓

↳ (Σ number of operations) ⇒ Time complexity

↳ Tree ki ht

↳ Har level se kitne calls : 9

81

1) $9 + 9^2 + 9^3 + \dots + 9^{81} \Rightarrow \frac{a.(r^n - 1)}{(r-1)}$

$= \frac{9(9^{81}-1)}{8}$ .K X ✓

$O\left(\frac{9(9^{81}-1)}{8}\right)$

1) Factorial : $5! \Rightarrow 5 \times 4!$

↳ $4 \times 3!$

↳ $3 \times 2!$

↳ $2 \times 1!$

↳ 1

ht : $n+1$

fact (n) → $n \times$ fact$(n-1)$

fact(n)

↓

$n \times$ fact$(n-1)$

↓

$(n-1) \times$ fact$(n-2)$

⋮

fact(1)

$T(n) = T(n-1) + 1$

$T(n-1) = T(n-2) + 1$

$T(n-2) = T(n-3) + 1$

⋮

$T(2) = T(1) + 1$

$T(1) = 1$

$T(n) + T(n-1) + \dots + T(2) + T(1) = T(n-1) + 1$

$T(n-2) + 1$

⋮

$T(1) = n$

$T(n) = O(n)$

2) Subsequence

① Tree ki ht: n

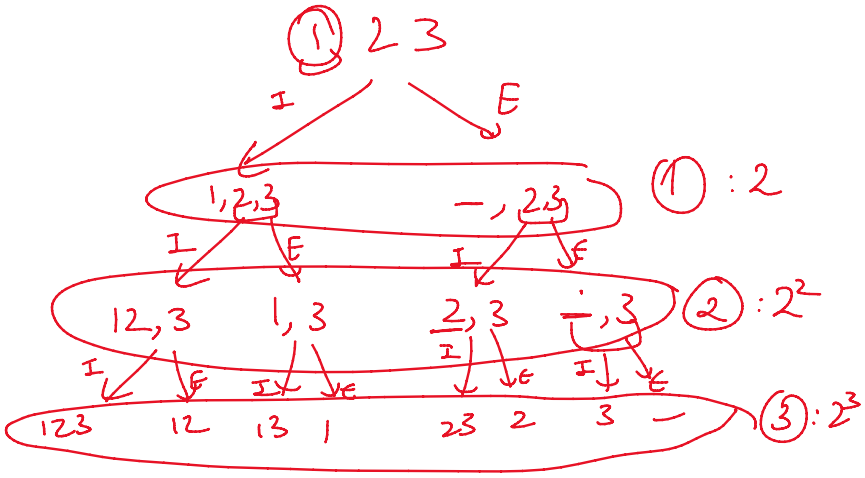
② Level par op? 2

$2 + 2^2 + 2^3 + \ldots + 2^n$

$= 2 \cdot \frac{(2^n - 1)}{2-1}$

$= 2^{n+1}$

$= O(2^n)$



② $T(n) = T(n-1) + T(n-1) + n$ (I, E)

$T(n) = 2T(n-1) + n$

$T(n-1) = 2T(n-2) + (n-1)$

$4\ T(n-2) = 2T(n-3) + (n-2)$

$\vdots$

$2^n\ T(1) = 1 \times 2^n$

$2T(n-1) = 4T(n-2) + 2(n-1)$

$4T(n-2) = 8T(n-3) + 4(n-2)$

$\vdots$

$T(n) = n + 2(n-1) + 4(n-2) + \ldots + 2^n \cdot 1$

$\leq n + 2 \cdot n + 4 \cdot n + \ldots + 2^n \cdot n$

$T(n) \leq n(1 + 2 + 2^2 + \ldots + 2^n) = n \cdot 2^{n+1}$

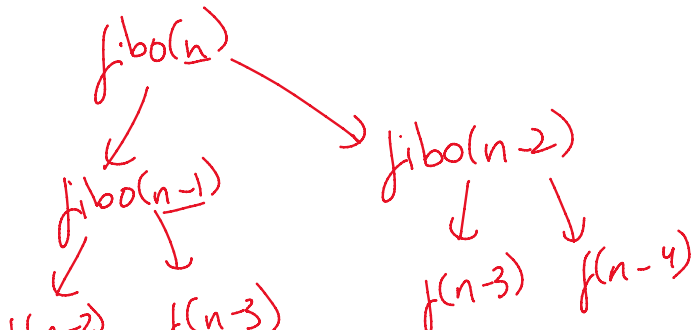
$= O(n \cdot 2^n)$ ✓

3) Fibonacci

Tree ki ht = n

ops at each level = 2

$\ldots + 2^n$

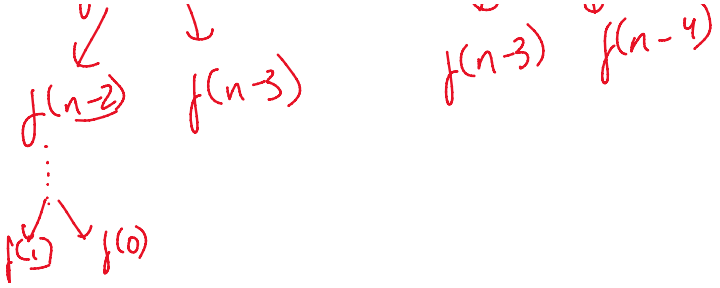


Ops at each

$1 + 2 + 2^2 + \dots + 2^n$

$= 2^{n+1}$

$= O(2^n)$



$T(n) = T(n-1) + T(n-2) + 1$

$\leq 2T(n-1)$

$T(n-1) = 2T(n-2) + 1$

$\vdots$

$T(n) = 2T(n-1) + 1$

$2T(n-1) = 4T(n-2) + 2$

$4T(n-2) = 8T(n-3) + 4$

$8T(n-3) = 16T(n-4) + 8$

$2^n T(1) = 1 \quad \times 2^n$

$T(n) = 1 + 2 + 4 + 8 + \dots + 2^n$

$= 2^{n+1} = O(2^n)$

✓ $T(n) = \underbrace{2T(n-1)}_{1 \cdot 2^n} + 1$ ← selfwork

SP

Recurrence

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Greedy Algo ✓

→ Best solution.