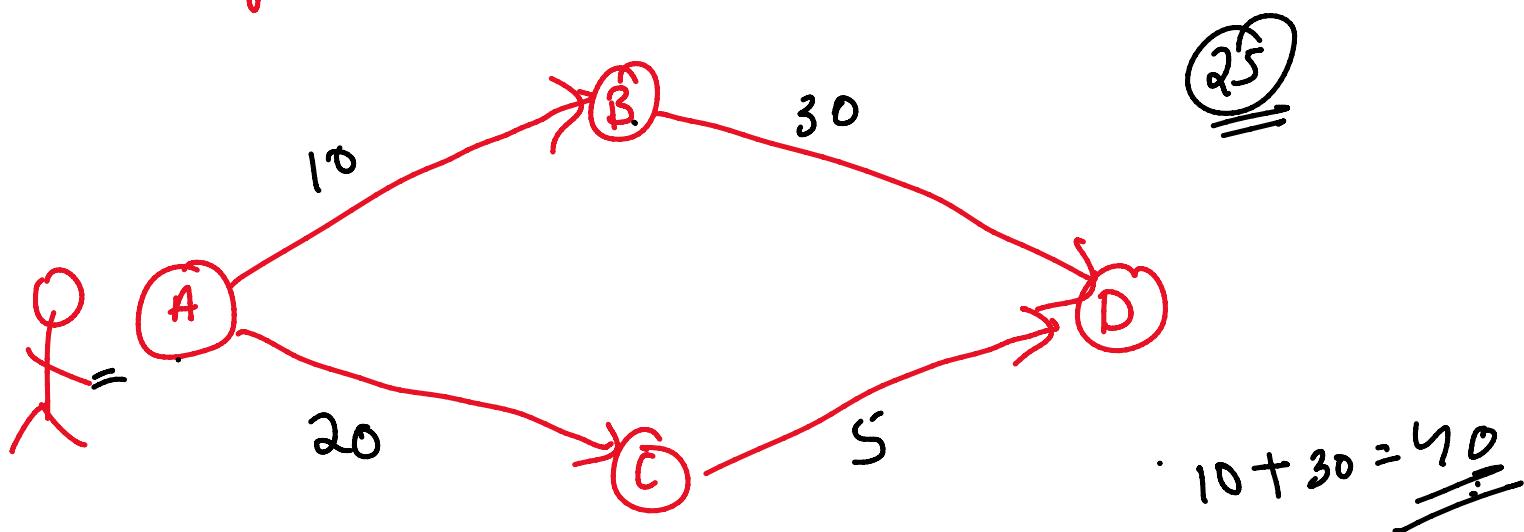


- It always makes the choice that looks best at a moment.
- making an optimal solution at each point of time

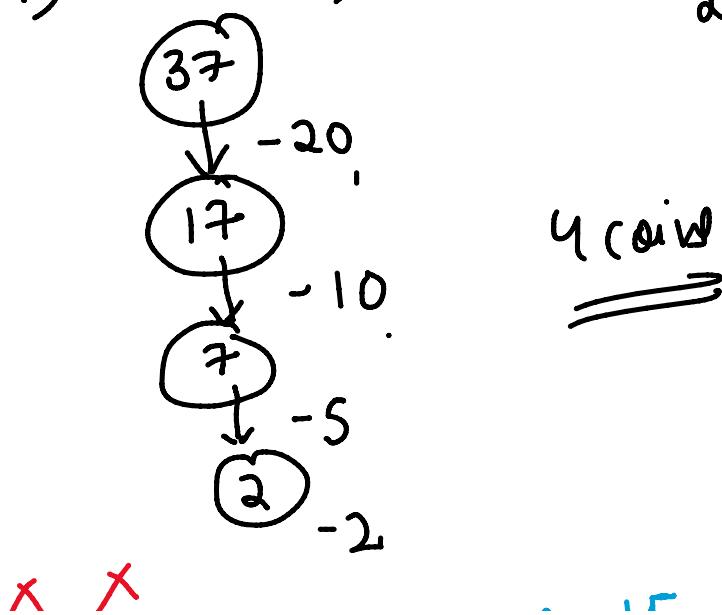


coin change

Indian currencies: [1, 2, 5, 10, 20, 50, 100, 200, 500, 2000]  
min no. of coins!

amount = 37

$$(20 + 10 + 5 + 2) = 4 \text{ coins},$$



$\sim -2$

coins:  $\{1, 7, 10\}$ ,  $\times \times$

3 coins

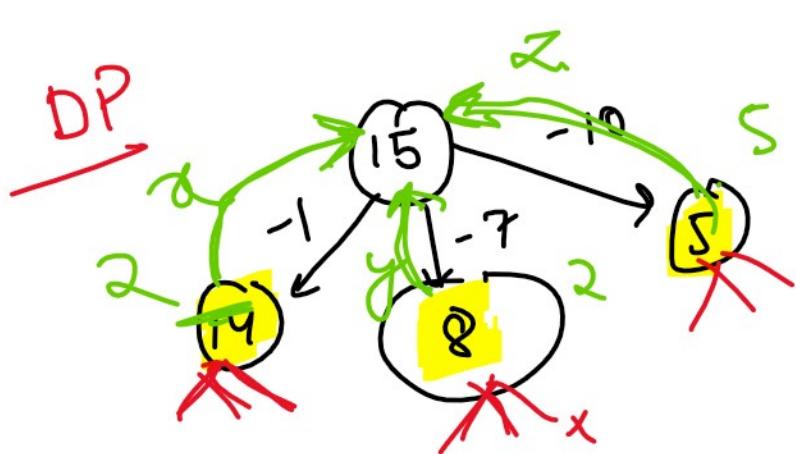
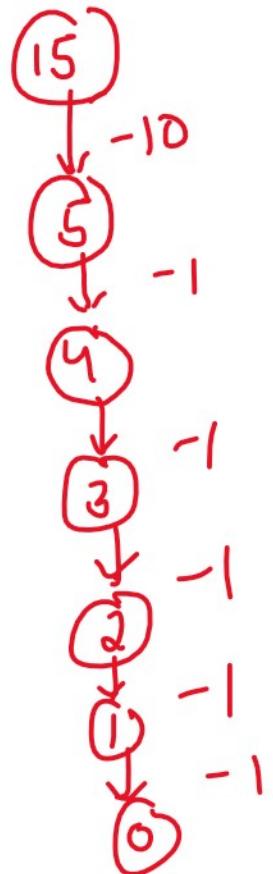
$(7, 7, 1)$

amount = 15

greedy

6 coins

$(10, 1, 1, 1, 1, 1)$

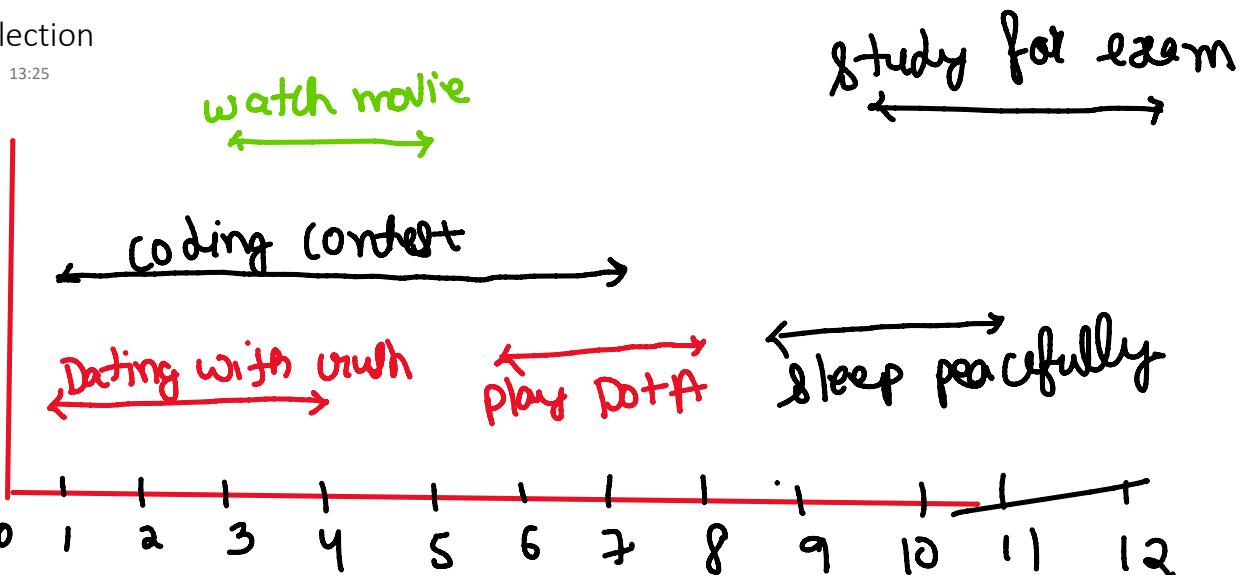


$$\min(x, y, z) + 1$$

= 3 coins

## Activity selection

07 October 2023 13:25

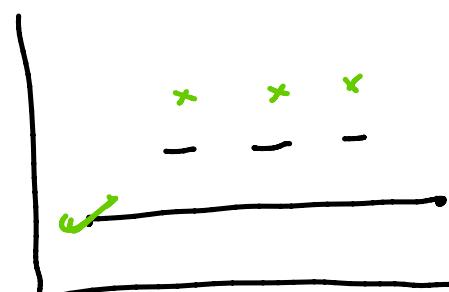
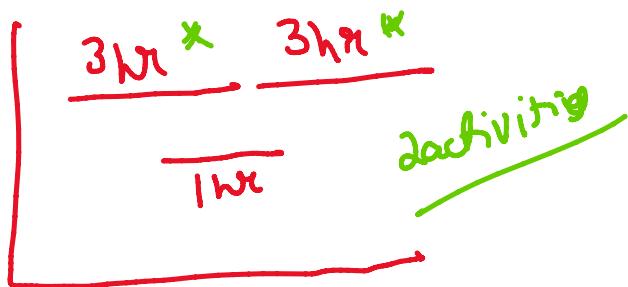


Do as much activities as possible.

$$\text{ans} = 3$$

$\rightarrow O(N^2)$

- ① sorting by end time.
- ② sorting by start time.
- ③ sort by duration.



activities start [1, 1, 3, 6, 9, 10]  
end [4, 7, 5, 8, 11, 12]

Pairs: (1, 2), (3, 5), (6, 8), (9, 11), (10, 12)

Pair  $(\overset{1}{1}, \overset{4}{4}), (\overset{1}{1}, \overset{7}{7}), (\overset{3}{3}, \overset{5}{5}), (\overset{6}{6}, \overset{8}{8}), (\overset{9}{9}, \overset{11}{11}), (\overset{10}{10}, \overset{12}{12})$

Sort by end time

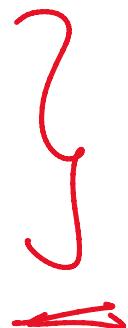
$\rightarrow (\overset{1}{1}, \overset{4}{4}), (\overset{3}{3}, \overset{5}{5}), (\overset{1}{1}, \overset{7}{7}), \cancel{(\overset{6}{6}, \overset{8}{8})}, \cancel{(\overset{9}{9}, \overset{11}{11})}, \cancel{(\overset{10}{10}, \overset{12}{12})}$

activity =  $\cancel{1} \cancel{2} 3$

Time  $O(N \log N)$   
Space  $O(N)$

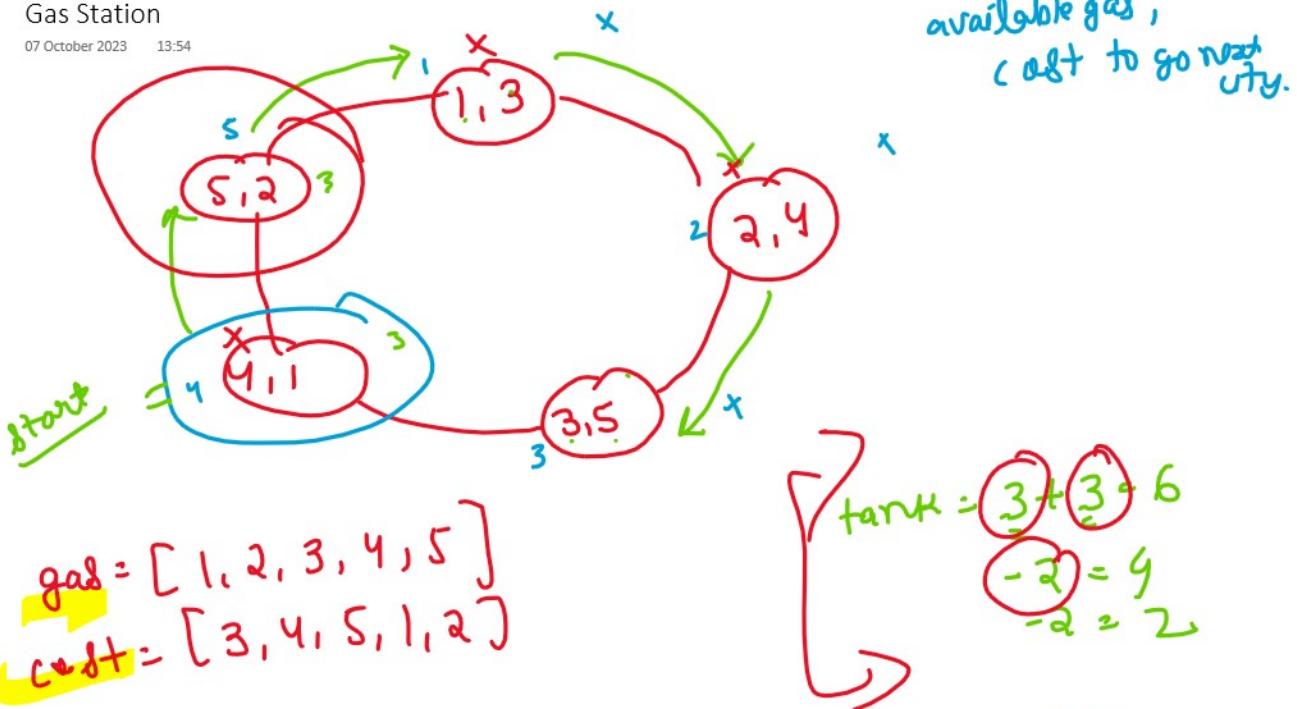
find a activity whose start time is greater than  
end time of curr activity.

- minimum platforms
- ~~min~~<sup>max</sup> no. of meeting rooms

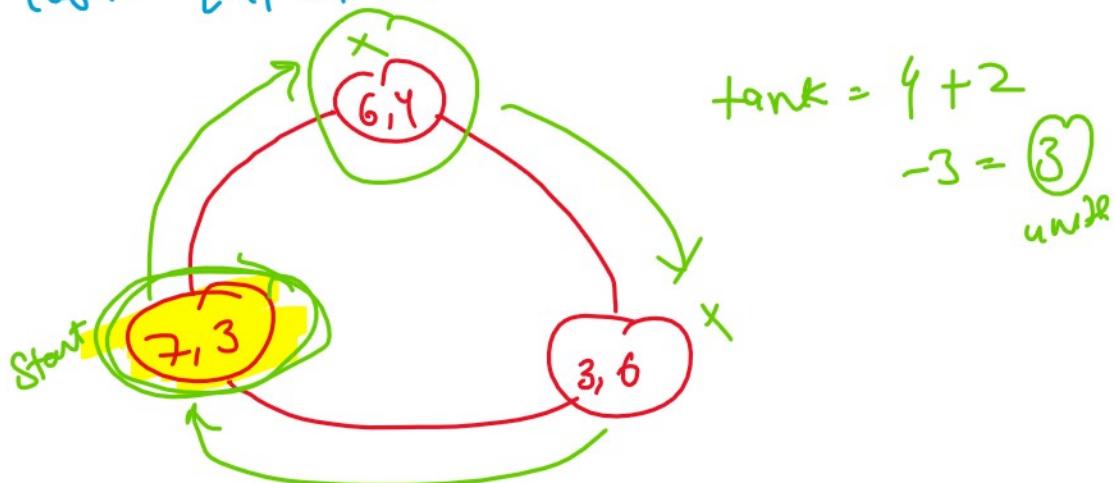


### Gas Station

07 October 2023 13:54



$$\begin{matrix} & 0 & 1 & 2 \\ \text{gas} = & [6, 3, 7] \\ \text{cost} = & [4, 6, 3] \end{matrix}$$



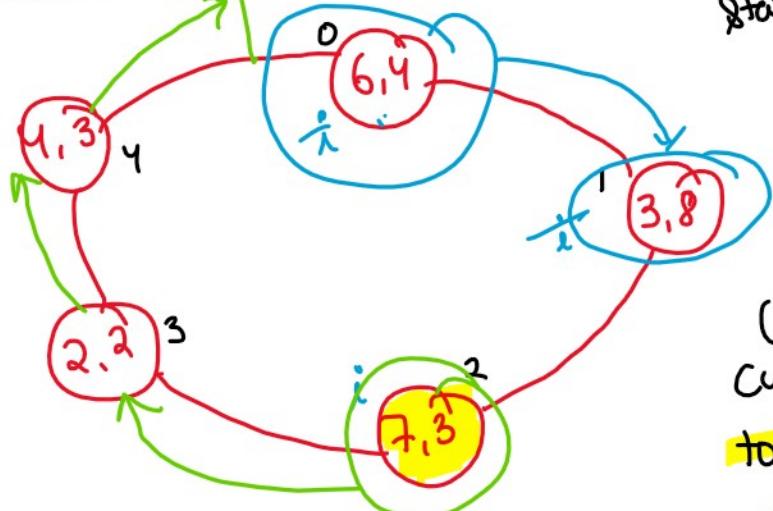
→ for every station check if it's possible to complete circular tour.  $O(N^2)$



(6,4), (3,8), (7,3), (2,2), (4,3)      index = 2

$(6,4), (3,8), (7,3), (2,2), (4,3)$

$\text{startIndex} = 2$



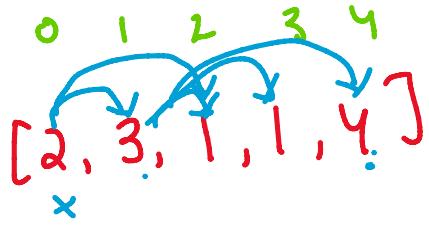
$$\begin{aligned} \text{(tank)} \\ \text{Current Balance} &= 2 - 5 - 3 + 0 + 4 + 0 + 1 \\ \text{totalBalance} &= 2 - 5 = -3 + 4 = 1 + 0 + 1 \end{aligned}$$

~~gas - cost = ?~~

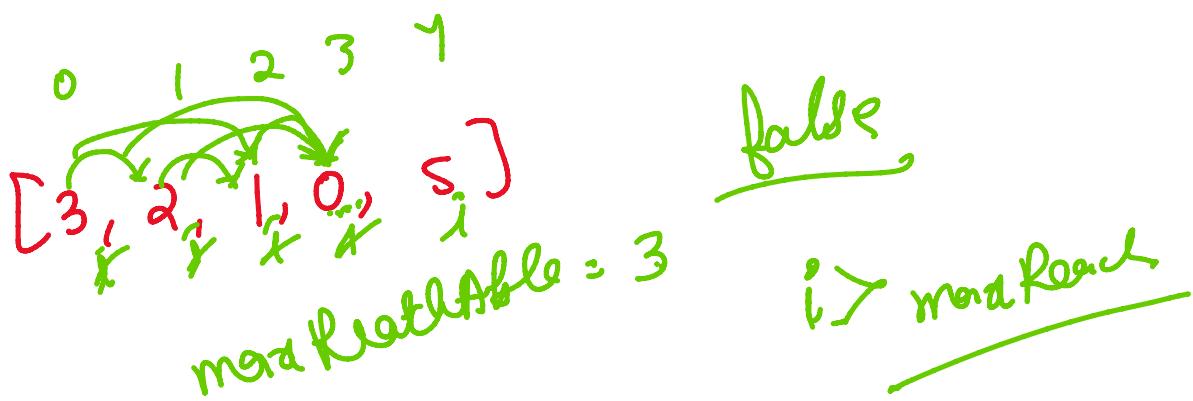
Timer  $O(N)$   
Space  $O(1)$

## Jump game

07 October 2023 14:33



maxReachableIndex = 2/4



Subproblemproblem

$$1+1+1+1+1 = 5$$

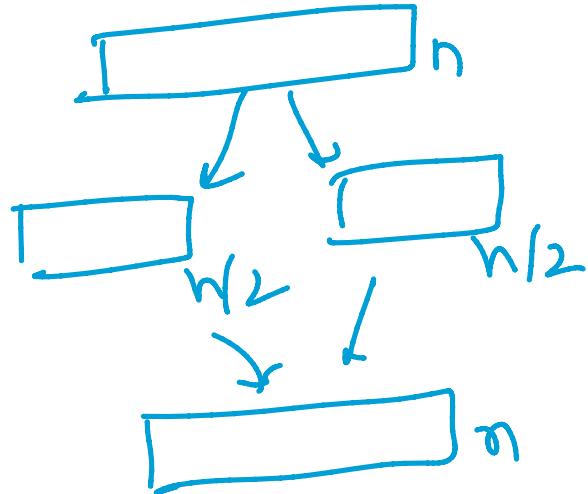
$$\underline{1+1+1+1} + \underline{1+1} = 6$$

 $\rightarrow O(N)$  ~~$O(N)$~~   
 $O(1)$ 

where?

① Optimal substructure

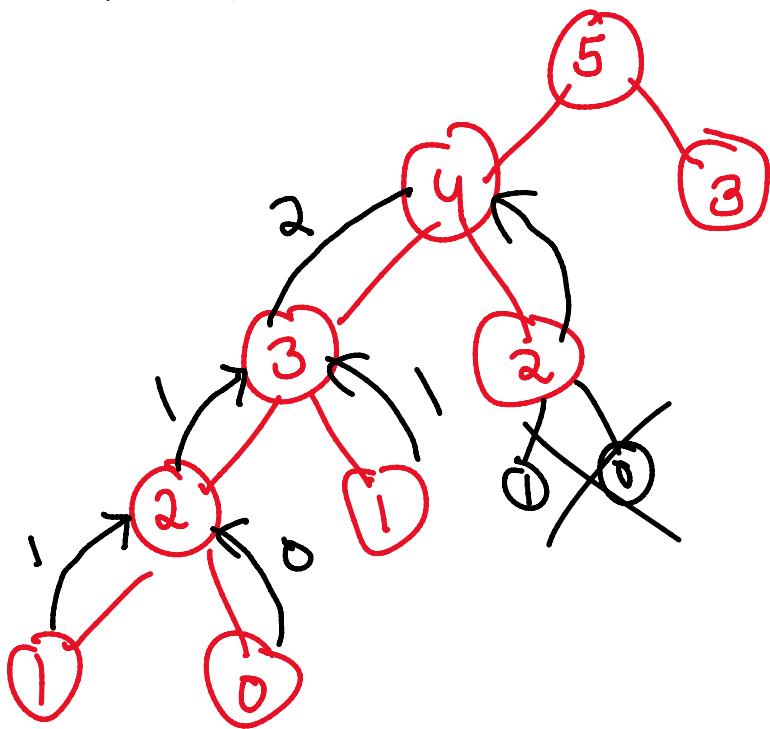
$$\text{sum}(6) = \text{sum}(\underbrace{5}) + \underbrace{1}_{\text{bigger subproblem}}$$



② Overlapping subproblem.

0, 1, 1, 2, 3, 5, 8, 13, ...

$$\text{fib}(n) = \text{fib}(n-1) + \text{fib}(n-2)$$



(Bottom-up + Memoization)

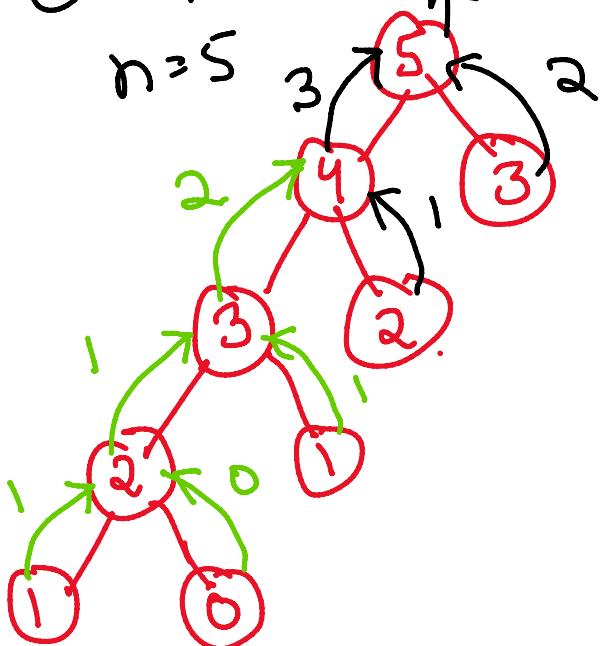
- ↙ ↘
- Top down (Recursion + Memoization)
  - Bottom Up (Iterative) [Tabulation]

## Fibonacci series

07 October 2023 15:09

find  $n^{\text{th}}$  fibonacci number.

① Top down (Recursion + Memo)



$$3+2=5$$

Bare Case  
if  $n=0, n=1$   
return  $n$

Time  $\in O(N)$   
Space  $\in O(N)$

dp array

0	1	1	2	3	5
0	1	2	3	4	5

② Bottom Up  
 $n=5$

$$dp[i] = dp[i-1] + dp[i-2]$$

dp array

0	1	1	2	3	5
0	1	2	3	4	5

Time  $\in O(N)$   
Space  $\in O(N)$

③ ~~3 variables~~  
~~a~~ ~~b~~ ~~c~~

$a$   $b$   $c$   
0 1 1 2 3

Time  $\in O(N)$   
Space  $\in O(1)$

## Coin change

07 October 2023 15:22

$$\text{coins}[] = [1, 7, 10]$$

min coins?

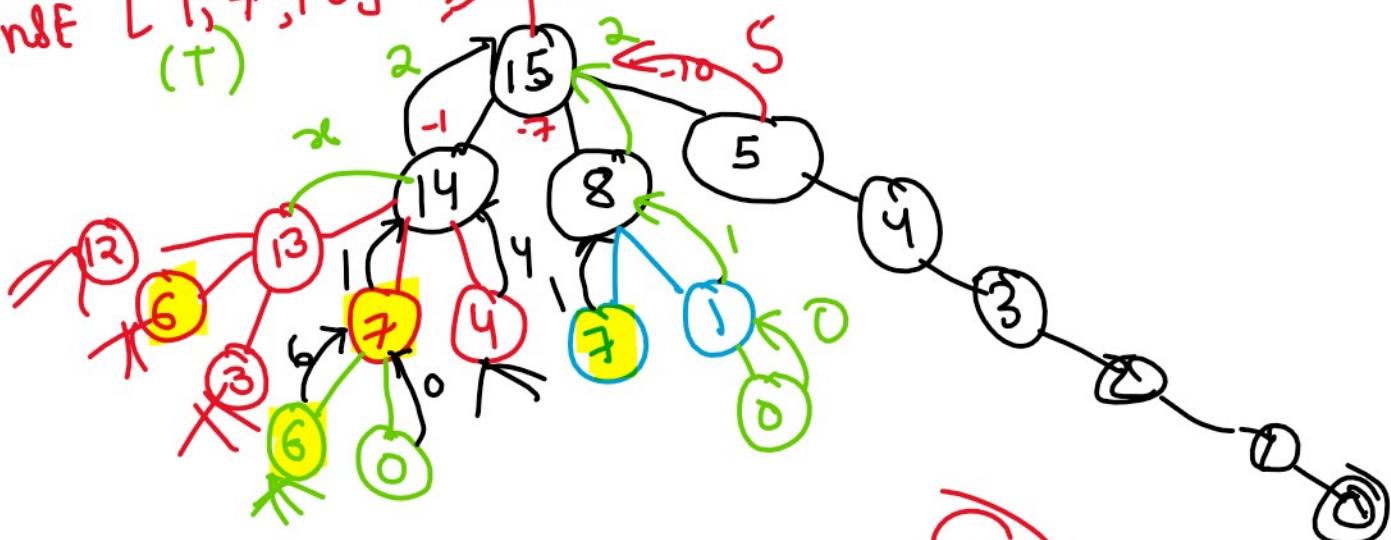
$$\text{amount} = 15$$

$$\text{ans} = 3 \\ (7, 7, 1)$$

~~10 + 1 + 1 + 1 + 1 + 1 = 15  
(6 coins)~~  
greedy

Top Down:

$$\text{coins}[] = [1, 7, 10] \quad (\text{T}) \quad \text{amount} = 15 \quad (2, 1, 4)$$



$$\min(2, 2, 5) + 1 = 8$$

$$\text{amount} = N \\ \text{coins}[] = T$$

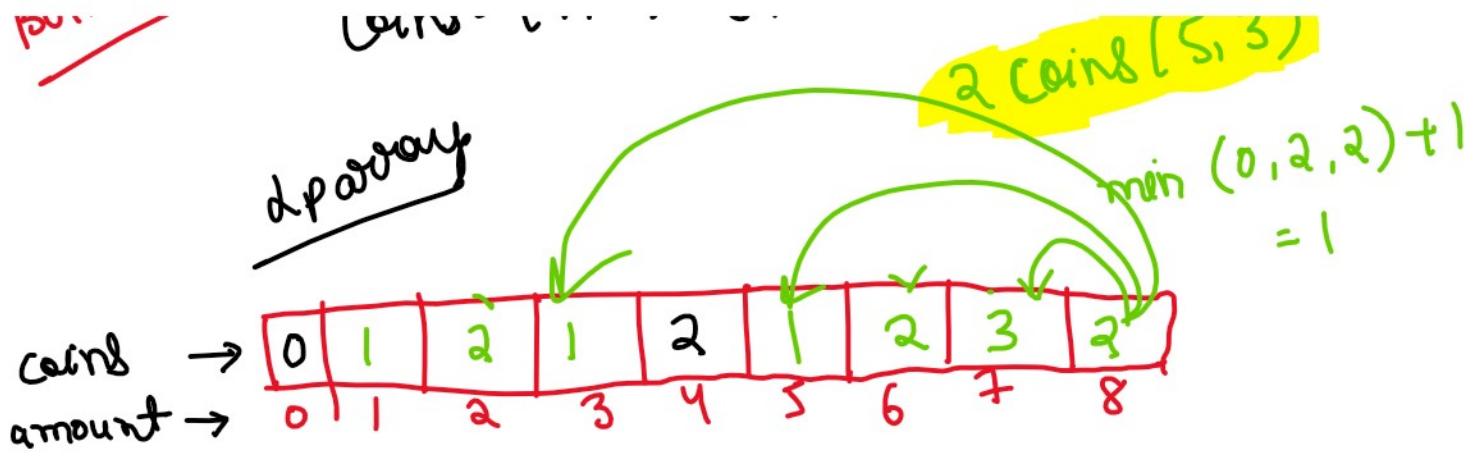
Time:  $O(N \times T)$   
Space:  $O(N)$

Bottom Up

$$\text{coins} = [1, 3, 5],$$

$$\text{amount} = 8$$

$$2 \text{ coins}(5, 3)$$



$$\min(1, 1) + 1 = 2 \quad 2 - 1 = 1$$

size = amount + 1  
amount + 1 / INT MAX

$$\min(2, 0) = 0 + 1 = 1$$

Time  $\in O(N^2)$   
Space  $\in O(N)$

coins = [20, 80, 90, 5, 1, 10, 20, 7, 100, 200]  
amount = 6

(1, 5, 7, 10, 20, 30, 80, 10, 100, 200)