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# ATCODER EDUCATIONAL DP Contest - Part 1

Q27 = A

Loop

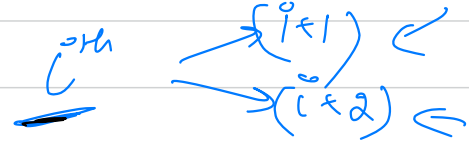
10		30		40		20
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start

- end

a[i]  $\rightarrow$  height of stone

$N \leq 10^5$



How can we solve it recursively ?

$\hookrightarrow$  Base case

$\hookrightarrow$  Recursive Intuition

$\hookrightarrow$  Self work

}

✓ Base Case ?? → what if you only had 1 stone → 0  
( $i=0$ ) = 0

$$f(i) = \min \left( |h_i - h_{i-1}| + f(i-1), |h_i - h_{i-2}| + f(i-2) \right)$$

min cost to  
reach the  $i^{\text{th}}$   
stone from  
1<sup>st</sup> stone

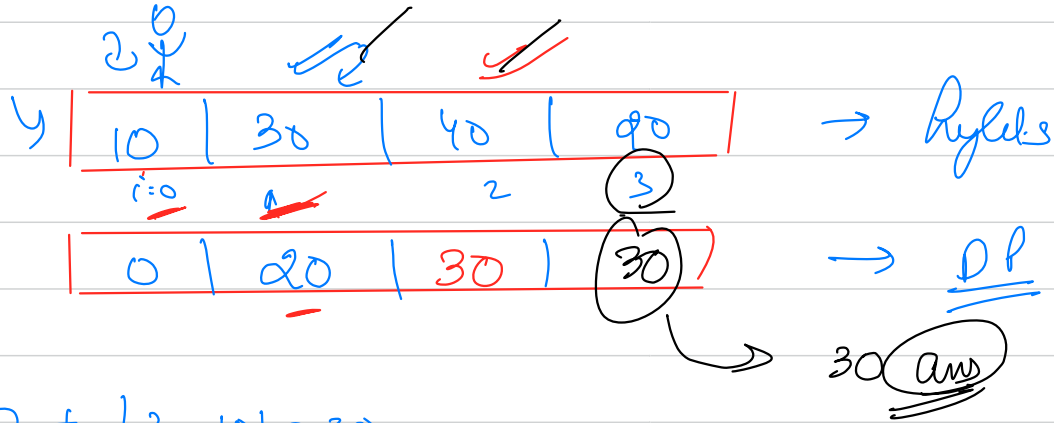
Top Down DP fibonacci → mod fees

TC ←  $O(n)$

+1

+2

(A)



$$0 + |30 - 10| = 20$$

$$\min(\underline{20} + |30 - 40|, 0 + |40 - 10|)$$

$$20 + |30 - 20|, 30 + |40 - 20|$$

$$(\underline{30}, 50)$$

$$f(i) = \min (|h_i - h_{i-j}| + f(i-j)) \quad \forall j \in [1, k]$$

recurrence (pointing to min)  
 loop (pointing to  $f(i-j)$ )

for  $k=2$  problem B is same as problem A

$$f(i) = \min (|h_i - h_{i-1}| + f(i-1), |h_i - h_{i-2}| + f(i-2), \dots, |h_i - h_{i-k}| + f(i-k))$$

TC  $\rightarrow$  a  $O(n)$   
 b  $O(n^2)$   
 c  $O(nk)$   
 d None

S-6

Problem C → Vacation

$i^{\text{th}}$  day

what activity can i  
do on the  $i^{\text{th}}$  day

→ 2 choices

(3)

any  $j^{\text{th}}$  activity on  $(i-1)^{\text{th}}$  day

→ We can't choose the activity that  
we choose on  $(i-1)^{\text{th}}$  day

Among the 2 choices we have we will pick  
the one with max points

$$f(i, x) = \begin{cases} p_a + \max(f(i-1, b), f(i-1, c)) & \text{if we choose activity } \underline{a} \text{ on } (i)^{\text{th}} \text{ day} \\ p_b + \max(f(i-1, a), f(i-1, c)) & \text{if we choose activity } b \text{ on } (i)^{\text{th}} \text{ day} \\ p_c + \max(f(i-1, a), f(i-1, b)) & \text{if we choose activity } c \text{ on } (i)^{\text{th}} \text{ day} \end{cases}$$

$f(i, x)$  is the max points obtainable on  $i^{\text{th}}$  day if we choose activity  $x$ .  
Recursion

$$\underline{f(i-1, a)}$$

for each day

$$\underline{\max(a, b, c)}$$

base case

	A	B	C
$i=1$	<u>10</u>	<u>140</u>	<u>70</u> ←
$i=2$	<u>20</u>	<u>50</u>	<u>80</u> ←
$i=3$	<u>30</u>	<u>60</u>	<u>90</u>

90, 120, 120

$dp_{i=1}$  ( A B C )  $\rightarrow$  max

$dp_{i=2} \Rightarrow$  ( 90 120 120 )  $\rightarrow$  120

$\rightarrow$  ( 150 180 210 )  $\rightarrow$  210

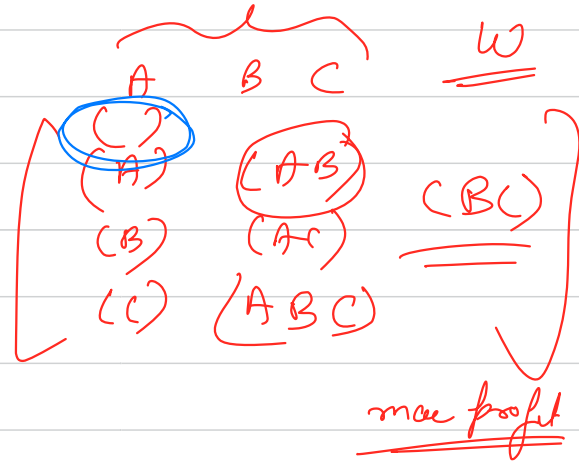


## Problem-0   Knapsack1

- for each item we can either choose the item  
→ if the weight permits or we can leave it.

Route Perce

Recurrent Relation



$$f(i, w) =$$

wt of knapsack

consider the  $i^{\text{th}}$  element, what max profit we can make

$$= \begin{cases} f(i-1, w) & \text{if } w[i] > w \\ \max(f(i-1, w), f(i-1, w - w[i]) + v[i]) & \text{or} \end{cases}$$

not chosen in element

choosing the  $i^{\text{th}}$  element

wt of knapsack is 0

no iter break

W=8

TC  $O(n \times W)$

$i=1$

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$dp[i][j] \rightarrow$  max profit with knapsack wt as  $j$  and all items till  $i$ th item

$\rightarrow dp[i][j] = dp[i-1][j]$

$dp[i][j] = \max(dp[i-1][j], v[i] + dp[i-1][j - wt[i]])$

Problem Knapsack 2

$f(i, j)$

profit to max

W

$f(i-1, j)$

if  $\frac{val[i]}{2} \geq j$

function which  
returns the minimum  
weight required to  
get a profit  $j$  with  
first  $i$  elements

$\min(f(i-1, j), w[i] + f(i-1, j - val[i]))$  che

possible case  
for  $(i = n-1)$

if all elements has  $10^2$  profit  $\rightarrow$  max profit  $n \times 10^3$   
 $10^2$   
 $j$  to  $\rightarrow$   $10^3$

Base Case

$i=0$   
 $i=1$   
 $i=2$   
 $i=3$

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
2	0	0	-	3	0	4	-	-	-	-	-	-	-	-	-
3	0														

dp [1] [3-5]

3

8 ← max profit

min (0, 4 + 0) (4)

min (4 + 3)

8 - 5

$i=1$   
 $wt$

$3$   
 $6$   
 $profit$

