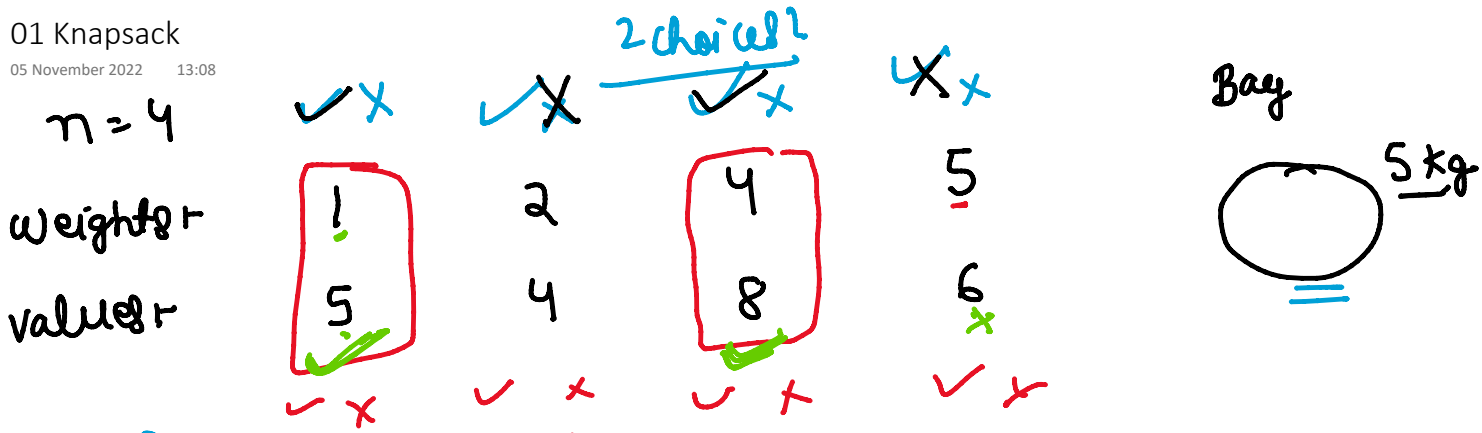
01 Knapsack

05 November 2022 13:08



3 kg, 9
5 kg, 13
~~6 kg, 11~~
~~6 kg,~~

max(include, exclude)

Greedy?

13

1 kg

max weight = 10

Greedy = 10

DP = 15

include

exclude

2^N →

w = 5 kg

weights	1	2	4	5
values	5	4	8	6

Base case

```
if (W == 0 || n == 0)
    return 0;
```

n → number of items

Top Down

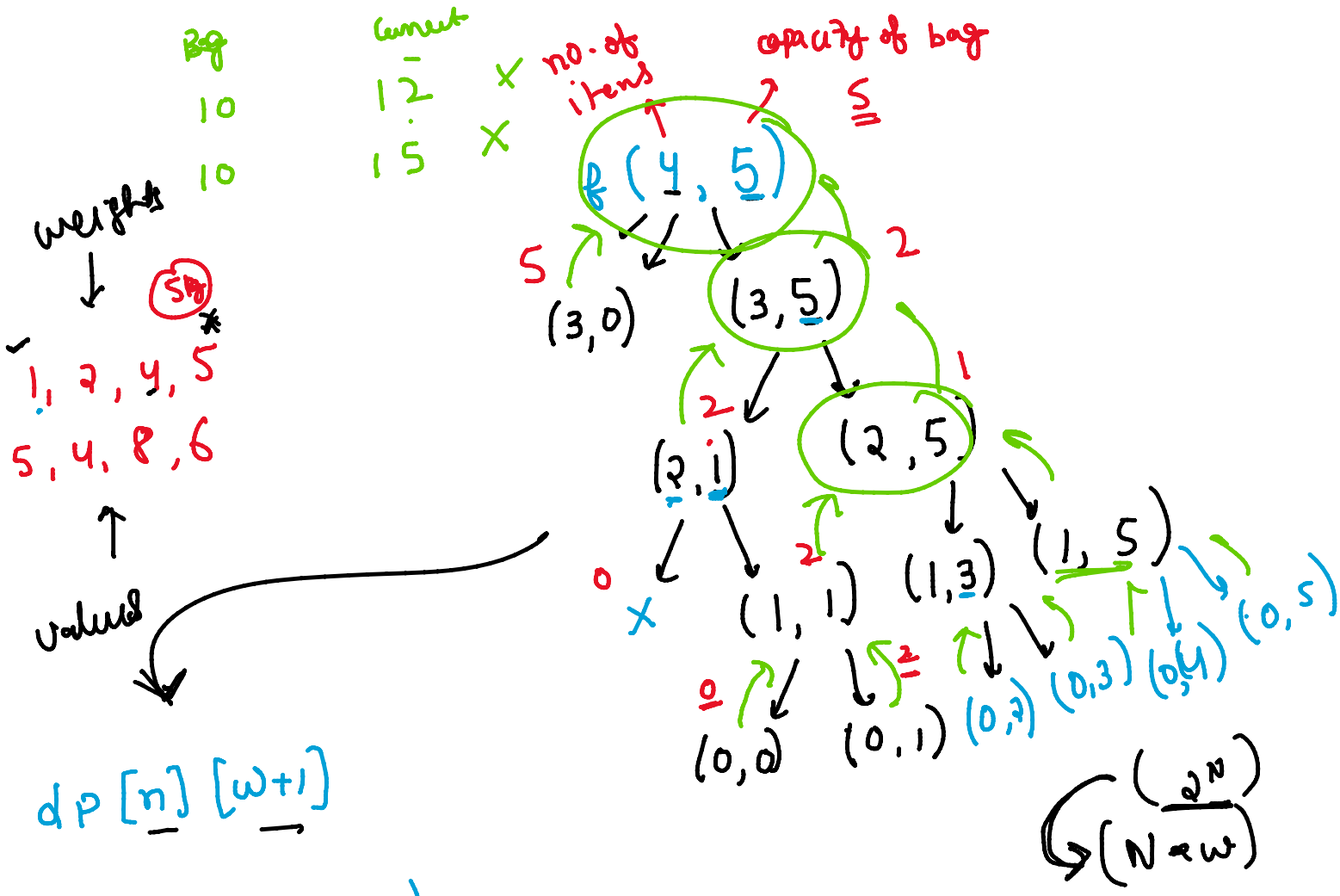
Bottom Up

Recursive case

```
if (current == total)
```

include : value[i] + fun(weights, value, $W_T - W_C$, n-1)

exclude : 0 + fun(weights, values, W_T, n-1)


Bag
10
10
weights
1, 7, 4, 5
5, 4, 8, 6
values
Current
12
15
no. of items
capacity of bag
f(4, 5)
(3,0)
(3,5)
(2,1)
(2,5)
(1,1)
(1,3)
(1,5)
(0,0)
(0,1)
(0,2)
(0,3)
(0,4)
(0,5)
dp[n][w+1]
Time - O(N*W)
Space - O(N*W)
(2^N)
(N*W)

House robber i

05 November 2022 13:56

2 7 9 3 1

Odd sum = 12
Even sum = 10

max (odd, even)

→ 12

10 7 9 10 3

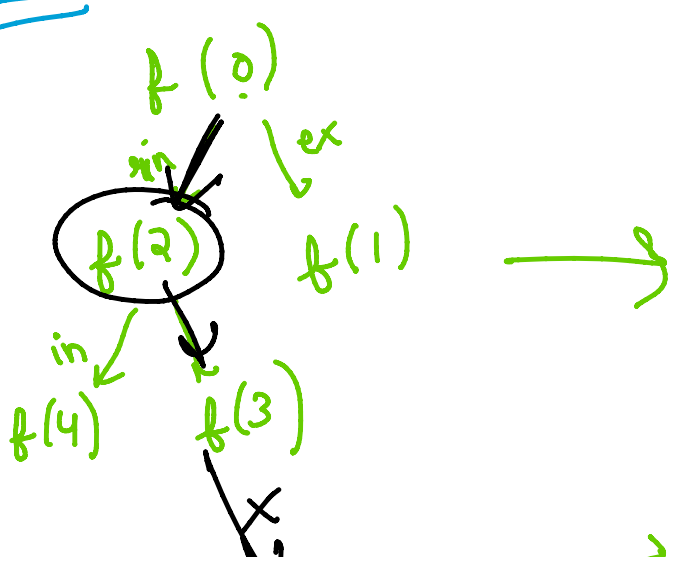
29
10

20 7 3 10

Oddsum = 23
evensum = 17

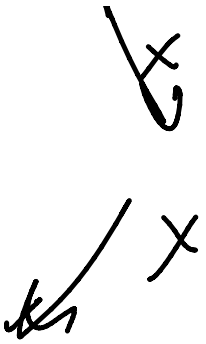
23

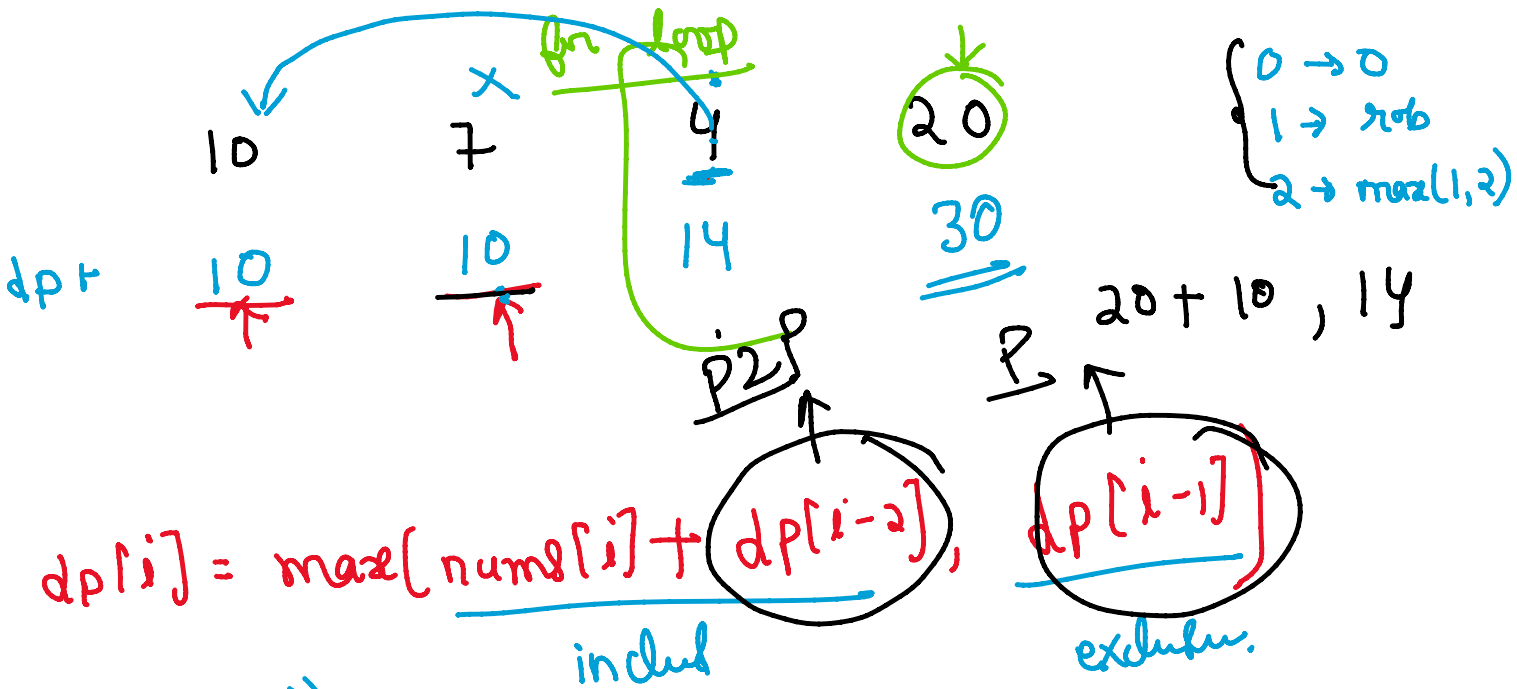
ans = 30



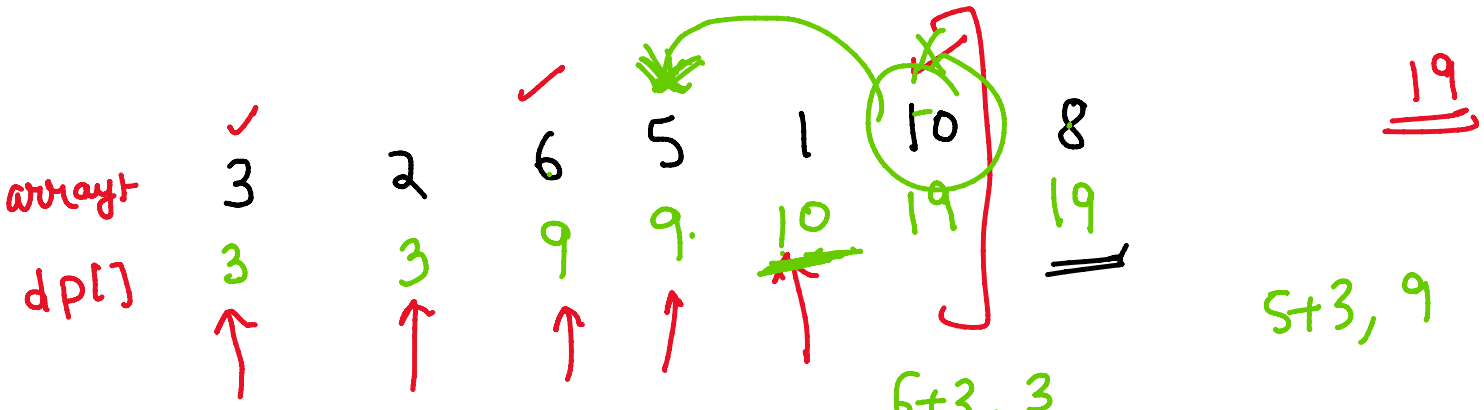
Top down

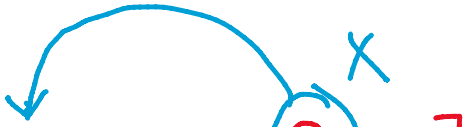
→ Bottom Upr





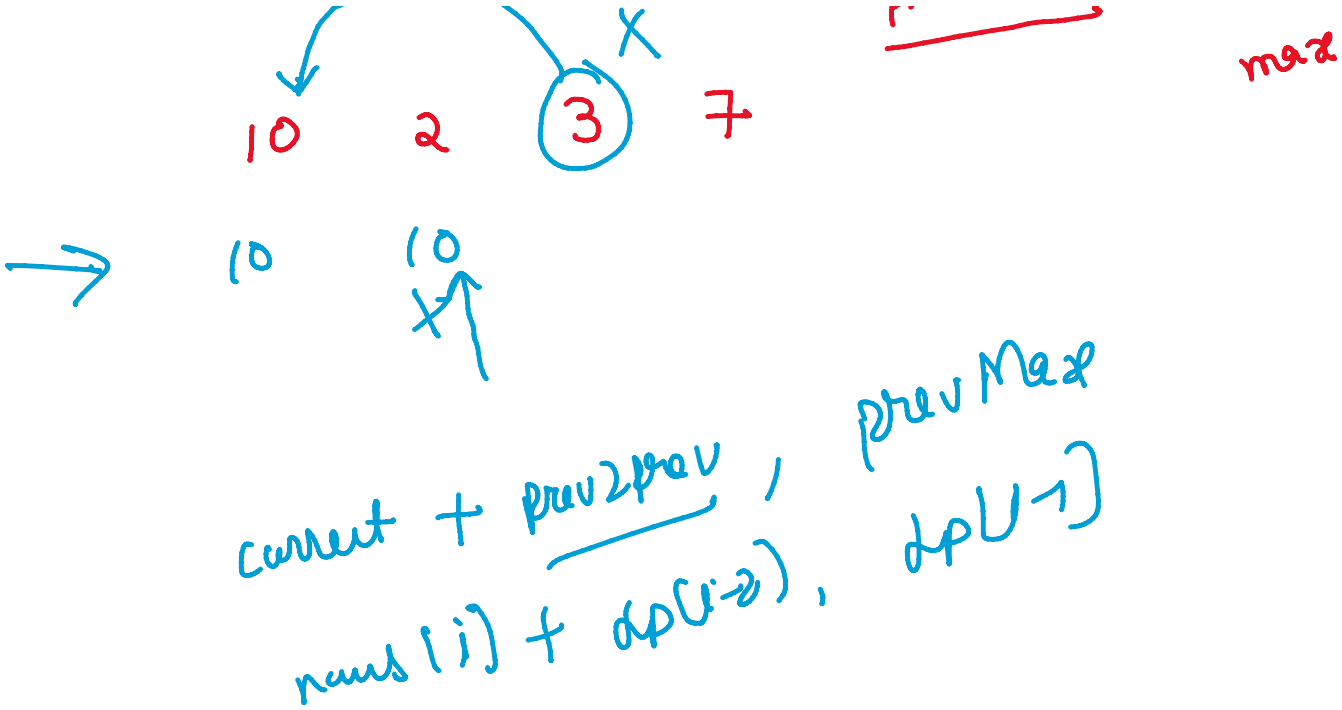
Time → O(N)
Space → ~~O(N)~~ O(1)





prev2prev, Prev

max

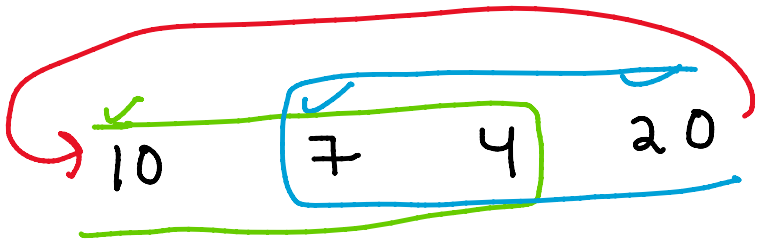


current + prev2prev , prevMax

nums[i] + dp[i-2] , dp[i-1]

House robber ii

05 November 2022 14:20



2 problems.

n houses

2 x dp

1 to n-1

2 to n

max

10 20 → 20 ans

	10	6	7	5	1	2	13
opt	10	10	17	17	18	19	0
opt	0	6	7	11	11	13	24

n-2

n-1

6 + 5 + 13 = 24

opt 19

opt 24

(10, 7, 2)

(6, 5, 13)

24

O(N)

O(1) ~~O(N)~~

Unique BST

05 November 2022 14:32

Catalan numbers :

C_0 C_1 C_2 C_3

1, 1, 2, 5, 14, 42, 132 .....

$C_n = C_0 C_{n-1} + C_1 C_{n-2} + C_2 C_{n-3} + \cdots + C_{n-1} C_0$

n=2

$C_0 = 1$ $C_1 = 1$

$C_2 = C_0 C_1 + C_1 C_0$

$= 1*1 + 1*1 = 2$

$C_3 = C_0 C_2 + C_1 C_1 + C_2 C_0$

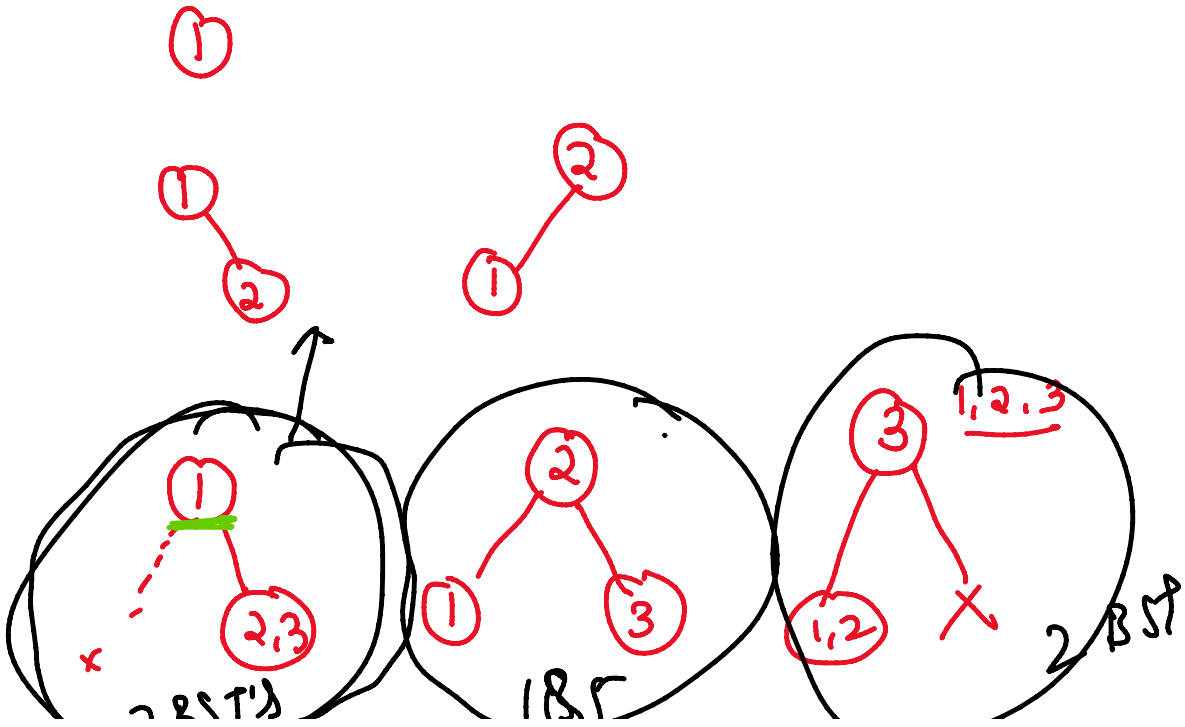
$= 1*2 + 1*1 + 2*1 = 5$

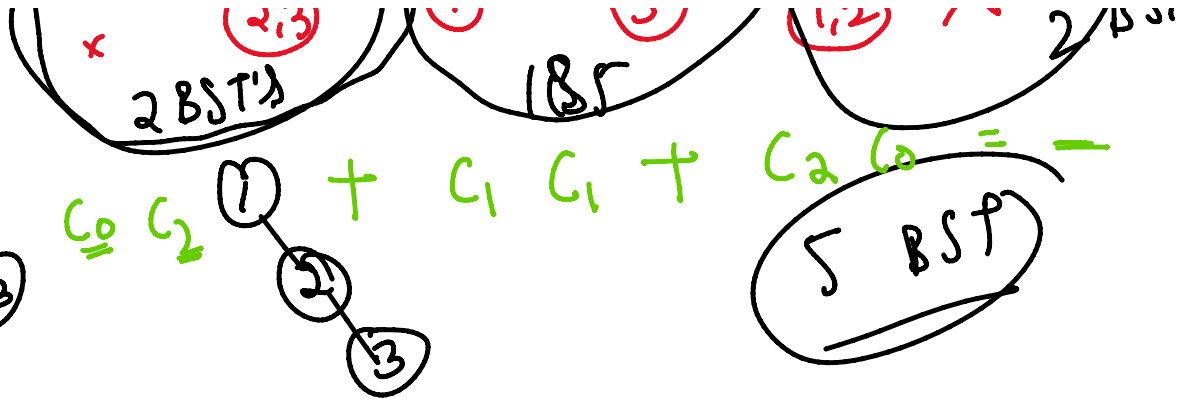
1, 2

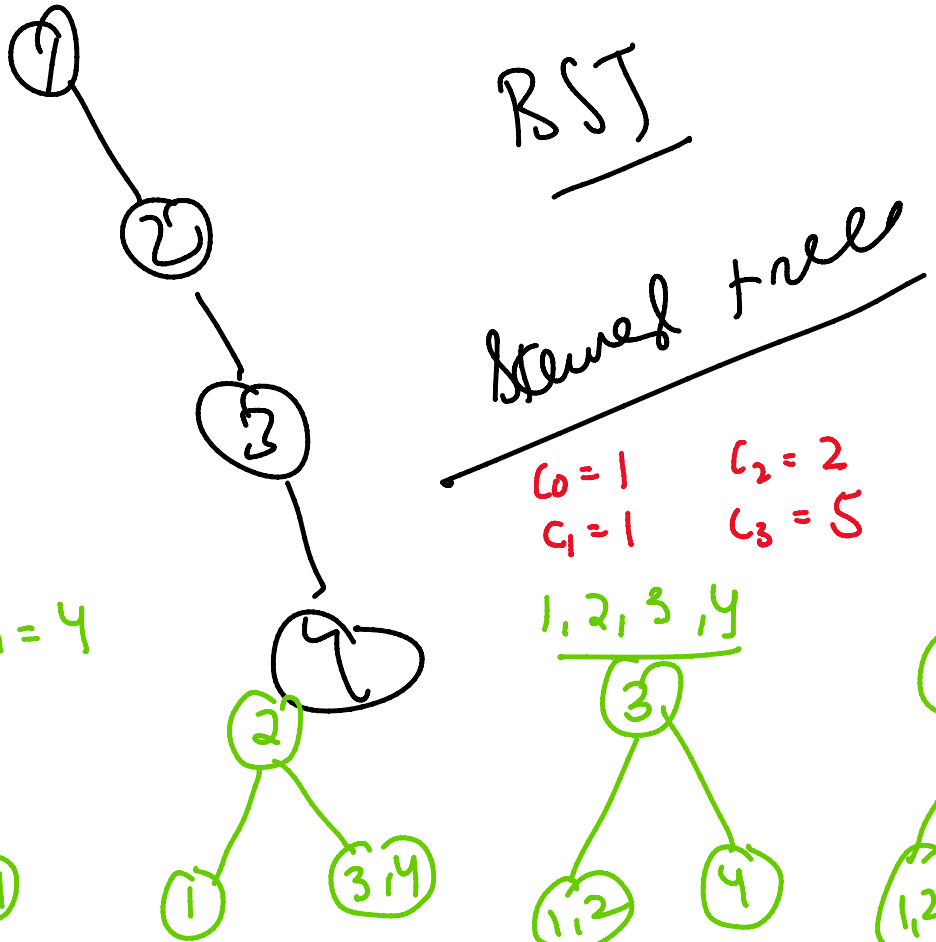
n=1

n=2

n=3




2 BST's
1 BST
5 BST
$C_0 C_2 + C_1 C_1 + C_2 C_0 =$

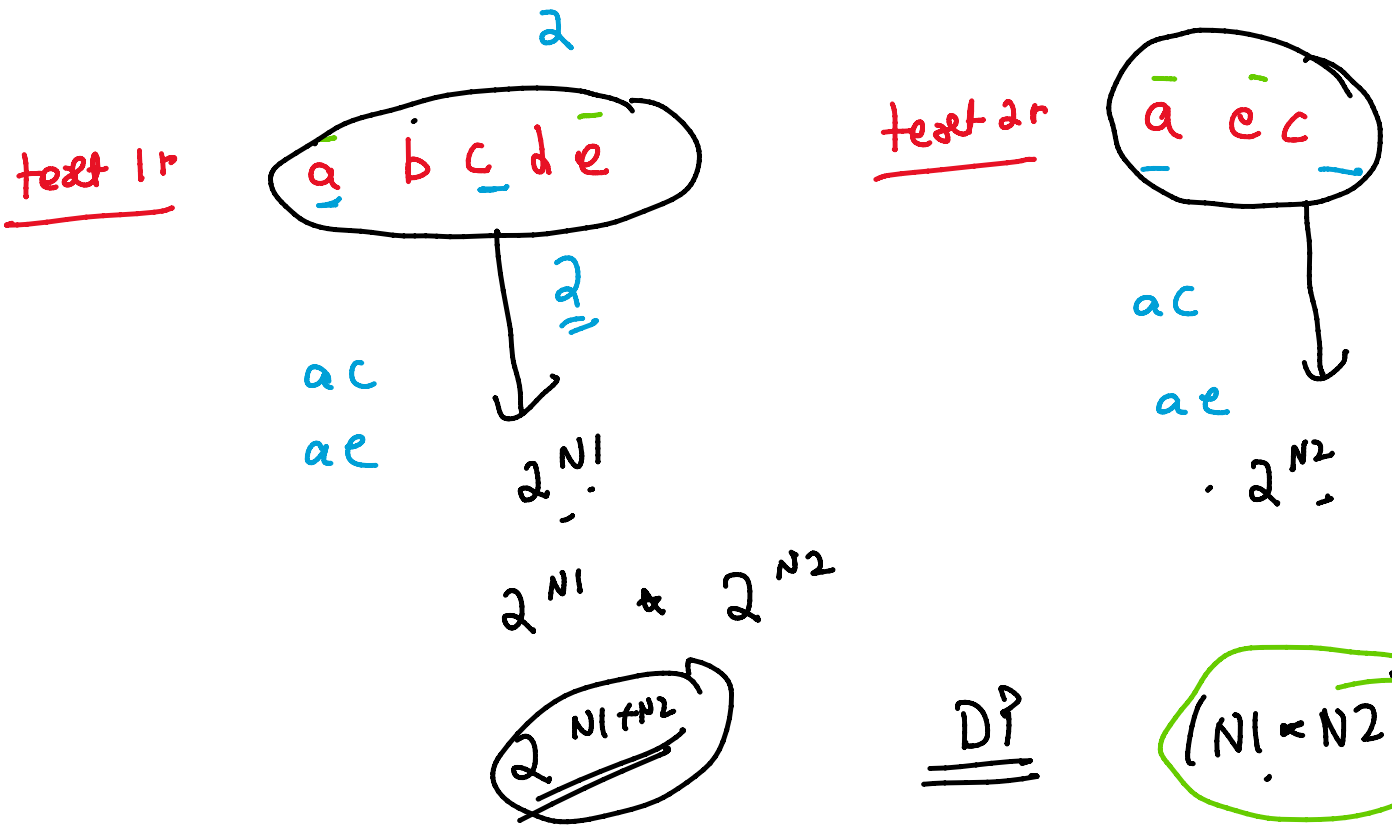

BST
Skewed tree
$C_0 = 1$ $C_2 = 2$
$C_1 = 1$ $C_3 = 5$
C_4 $n = 4$
1,2,3,4
14
2,3,4
1
3,4
1,2
4
1,2,3
$C_0 C_3 + C_1 C_2 + C_2 C_1 + C_3 C_0$
$1 \times 5 + 1 \times 2 + 2 \times 1 + 5 \times 1$
$5 + 2 + 2 + 5 = 14$

LCS

05 November 2022 15:16

text1 : a b c d e

text2 : a z c y



$2^{N1} * 2^{N2}$

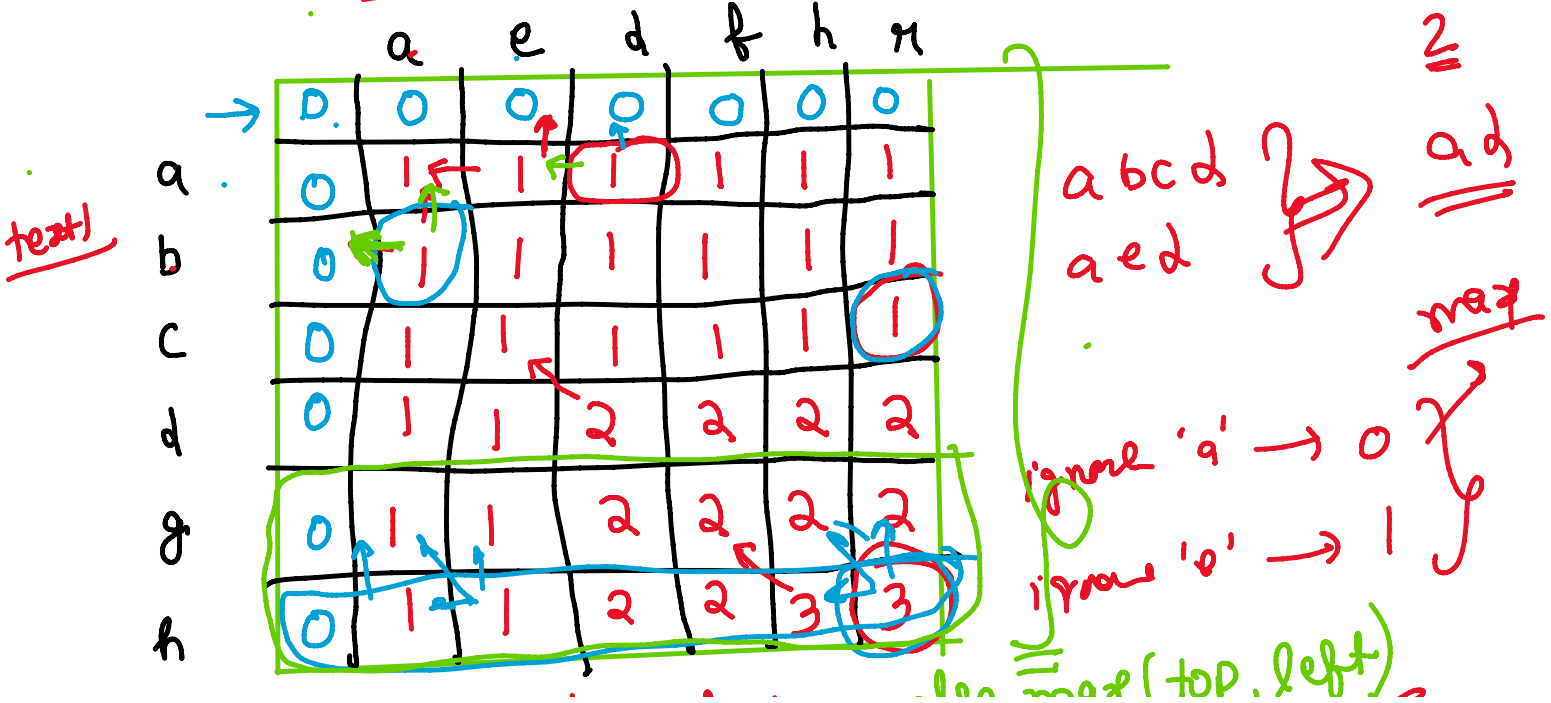
2^{N1+N2}

DP

(N1 * N2)

text1 : a b c d g h

text2 : a e d f h x



if chars are matching, diagonal + 1

else max(top, left)

(N1 ≠ N2)

(N1 ≠ N2)

Wildcard matching

05 November 2022 15:38

? → single char

* → zero or more

a?*c? → abcde ✗, abbcc ✓

a*b*a → ab ✓, axyb ✓, cab ✗, abc ✓

phonepe

Amazon → A222

Agazon → A4n

Amazon → A6

s = a l b m n c c

p = a ? b * c (pattern)

s = a l b m n c

p = a ? b * c

		a	?	b	*	c
	T	F	F	F	F	F
a	F	T	F	F	F	F
l	F	F	T	F	F	F
b	F	F	F	T	T	F
m	F	F	F	F	T	F
n	F	F	F	F	T	F
c	F	F	F	F	T	T

m, n, c

" * → True

① if chars are matching or here is ? then check diagonal.

② * → empty (left)

* → some of the (top)

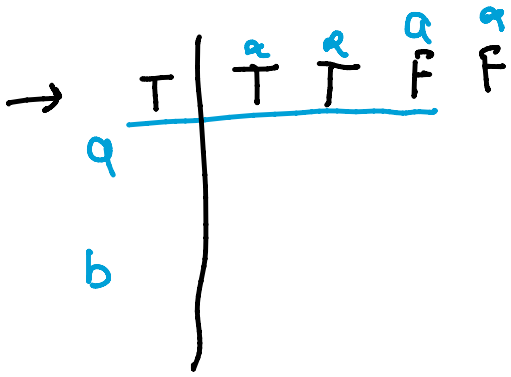
a l b m

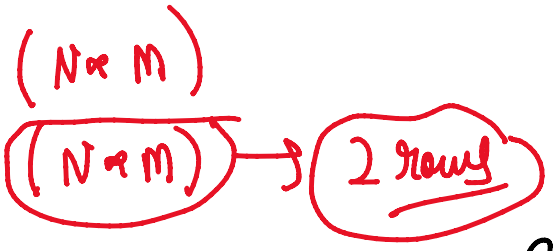
a ? b ✗

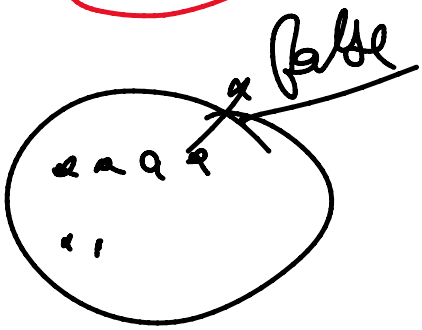
a l b

a ?

edit distance







Dijkstra's algorithm

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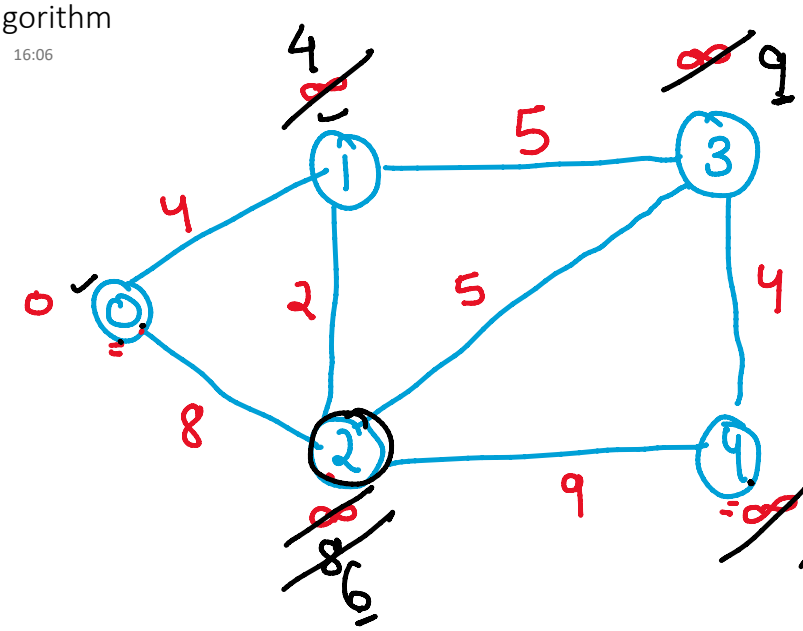

visited	unvisited
{ }	{0, 1, 2, 3, 4}
{0}	{1, 2, 3, 4}
{0, 1}	{2, 3, 4}
{0, 1, 2}	{3, 4}
{0, 1, 2, 3}	{

8, (4+2)

DP Practice

05 November 2022 16:17

1. Edit distance
2. Decode ways
3. Best time to buy and sell stock i, ii, iii, iv
4. Maximal square
5. Regular expression matching
6. Word break i, ii