6]

my summary DP

① accumulative = 1-d style dp

- Fibonaccie
- longest common seq
- only one array [subarray]

Type 1

→ F(0) & F(1) ⟶ = Bottom up

F(n), F(n-1) ⟶ F(0) Top Button

② Target + array = Bottomup = 2d array

Type 2

not subarray

- min To get The Target
- is it possible to get The Target
- How many ways

③ array + array + Target

0/1 knapsack

1	3	4	5	weight
1	4	9	7	val

Table weight = 7

Bottomup = 2d array

Type 3

④ 2 array / 2 string ⇒ ① ---- + subsequance [palindrome ---

Type 4

same arr diagonal

2 diff array row by row

subarr ~~can~~ subseq ~~will~~ ② To convert S1 To S2

5) Decision Tree + memoization

recursion + memoization

Types

Top-bottom

1]

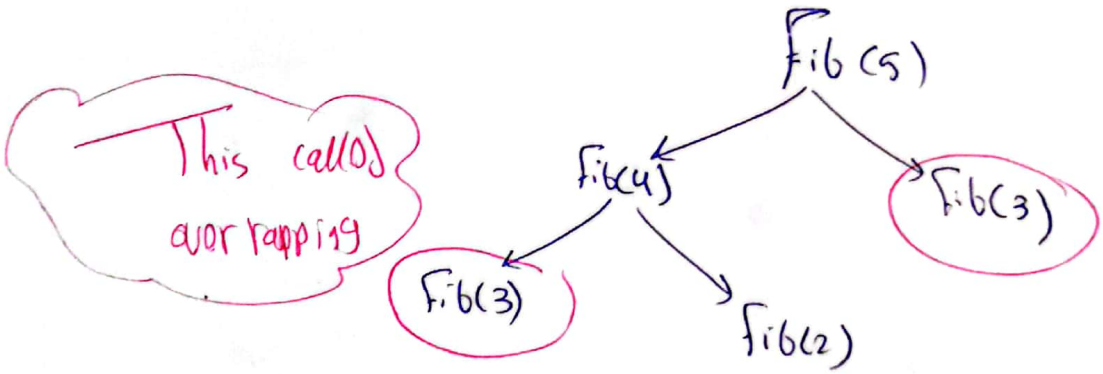
Dynamic programming

It could solve problem o(n) instead of (2^n)

= optimation Technique

*Dynamic programming → optimal sub structure → sub problem of main problem

→ overlapping sub problems



* 2 Types of problem : ① combinatoric problems

② optimation "

*combinatory : How many? - How many ways To make echange

- " " " To Traverse graph

- " " steps To get from A To B

- count The total number of solution

-optimation problems: -what is the min number of steps needed to get from A to B?

- what is the min coins to get sum?
- " " max profit

• DP is Technique to solve combinatory and optimization problem that is optimal solution depends on optimal solution to overlapping sub problems.

Frame Work of DP
5 = steps

1- Define objective function
f(i) is distinct ways ...
2- get base cases ⇒ f(0), f(1) ..
3- find the relation = العلاقة pattern بين
4- order of computation ⇒ [botten-up]
5- location of the answer

(ex) 0 1 2 3 4
1+2+3+4+5+.... what is the summation

f(4) = 5 + f(3)
f(5) = f(4) + 6

} نوع من الـ memoization

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

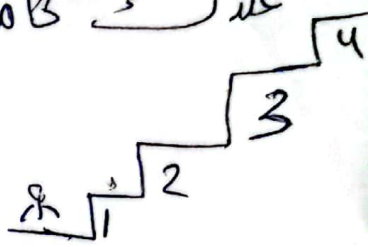
الحد يعتمد على اللي

DP: breaking down the problem into simpler sub problem

3]

عندك سلم و بتطلع سلمة واحدة او سلمتين مع بعض
عندك كام طريقة ؟

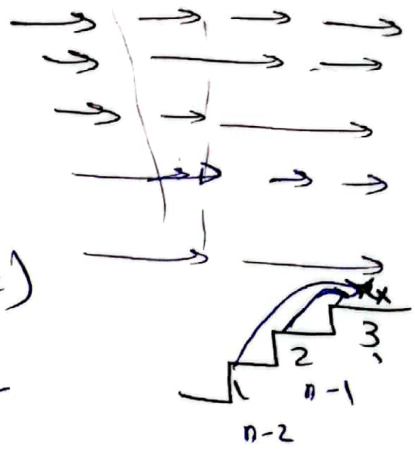
Type 1



دايماً افترضها سلم واحد
وبعدها سلمتين
و // ٣ وطلع العلاقة

$$f(1) = 1$$
$$f(2) = 2$$
$$f(3) = 3$$
$$f(4) = 5$$

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



عشان نروح لـ ٣ ⇐ عندك اختيارين فقط [2 و 1]

* $f(n+1) = f(n) + 1$ ⇒ Future values

#تحدي يوم

Type1

عشان نحل DP عندي اسلوبين للحل

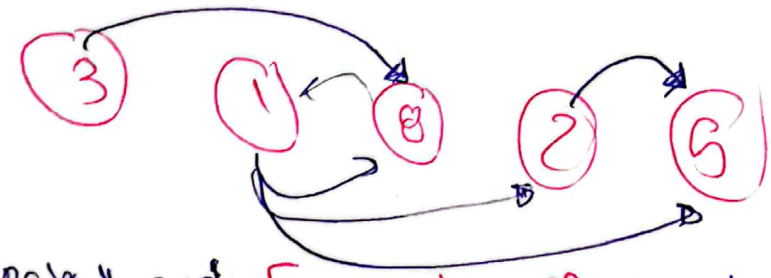
1- memoization
2- Tabulation

Q] Find The longest increasing subsequence (LIS)

3,1,8,2,5

= 3 elements

1) Visualize



انت كده هتقف عند node وتحسبي ليها F(i) عدد الـ nodes اللي جاية ليها

وهتروح اللي قبليها سؤالين

1- هل اللي انا فيها؟!
2- ايه الحاجة اللي جاية ليا؟!

F(0) = 1
F(1) = 1
F(2) = 2

$$L[A] = 1 + \max\{ L[k] \Big|_{k=0}^{n-1} \cdot \text{if } A[k] < A[n] \}$$

Code

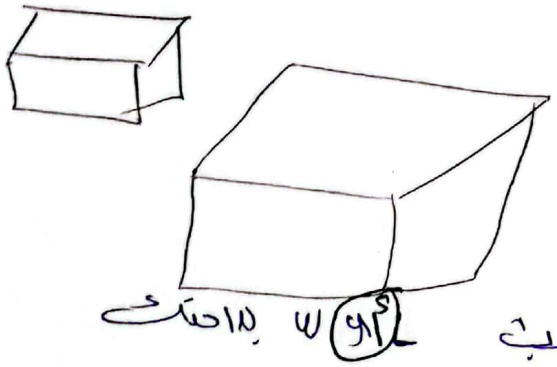
2

BoxStacking ⇒ Box has [Length, width, height]

Type 1

What is The heighest of The tallest possible stack??

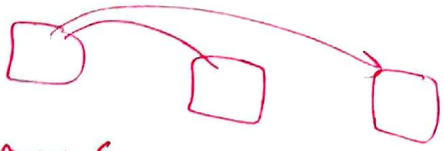
Sol



لو حابب لازم تعمل Sort من كبير لصغير بالمساحة و(الارتفاع)

State machine

لازم { 1- هل الـ Box ممكن أحطه فوقها
2- أنا الطول الي وصلت



Height[n] = Box[z] + max { Height[k] | k=0 to n-1 }

Box Height[z]

if only { width_k < width_n && length_k < length_n }

Code

4]

Find number of {0|0|0} given n

type

n = 3 ⇒ output = 6

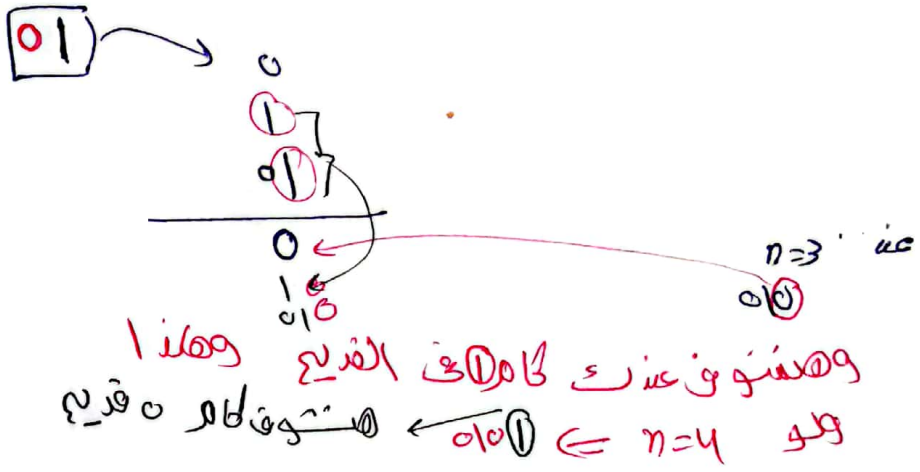
{0|0|0}

0
1
0
01
10
010

6

n = 1 ⇒ A = 1

n = 2 ⇒ A = 3



code:

57]

Q] Yaseira given array of cost ⇒ min cost To reach The end of Stair case: known That you can Jump (1) OR (2) steps. you can start from Index 0 (OR) Index (1)

Type 3

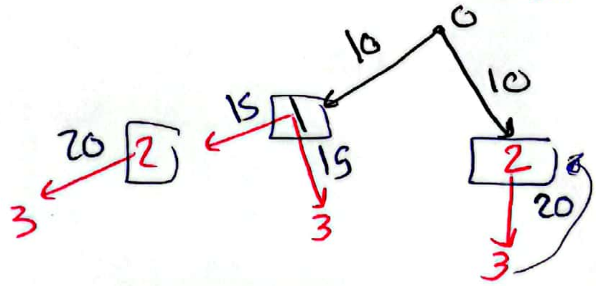
[10, 15, 20] (indices 0, 1, 2, 3)

Sol — sol is (15)

الفكرة كلها انت مش عارف انت عايز توصل لـ index رقم ٣ اعتبرت في هتبدأ من رقم 0 ولا رقم 1

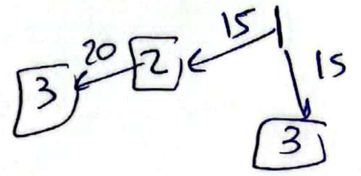
Sol ① ⇒ recursion + memoization

→ start at 0
→ " at 1 } → min



الـ Base هيرجع zero

الى عليها (هنكت a[i]) sum



⟸ هنعمل call تانى منفصل

هاخد min من ① و ⓪

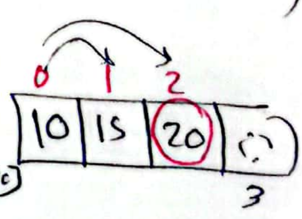
code = [ ]

Sol2 : dp ⇒ انت مش عارف البداية بس عارف النهاية فخلاص البدأ من النهاية لحد ورا

} ans = min(dp[0], dp[1])

dp[2] = 20 → عشان يروح لـ ٣ ⇐ دى تكلفة

dp[1] = min(15+0, 15+20)



dp[0] = a[0] + min(dp[1] + dp[2])

code = [ ]

$dp[i] = a[i] + \min(dp[i+1], dp[i+2])$

Type 1

91. Decode Ways

Solved

Medium | Topics | Companies

A message containing letters from `A-Z` can be **encoded** into numbers using the following mapping:

```
'A' -> "1"
'B' -> "2"
...
'Z' -> "26"
```

To **decode** an encoded message, all the digits must be grouped then mapped back into letters using the reverse of the mapping above (there may be multiple ways). For example, `"11106"` can be mapped into:

- `"AAJF"` with the grouping `(1 1 10 6)`
- `"KJF"` with the grouping `(11 10 6)`

Note that the grouping `(1 11 06)` is invalid because `"06"` cannot be mapped into `'F'` since `"6"` is different from `"06"`.

Given a string `s` containing only digits, return *the **number** of ways to **decode** it*.

The test cases are generated so that the answer fits in a **32-bit** integer.

Example 1:

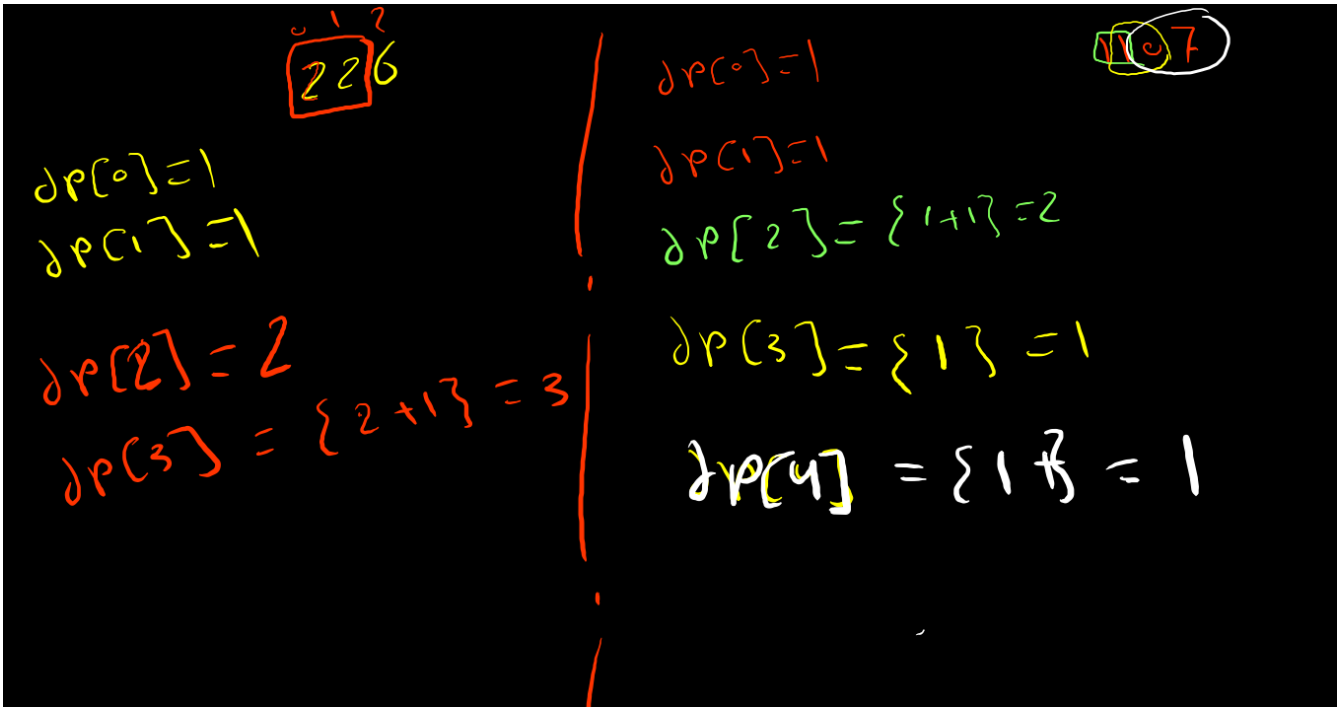
```
Input: s = "12"
Output: 2
Explanation: "12" could be decoded as "AB" (1 2) or "L" (12).
```

Example 2:

```
Input: s = "226"
Output: 3
Explanation: "226" could be decoded as "BZ" (2 26), "VF" (22 6), or "BBF" (2 2 6).
```

Example 3:

```
Input: s = "06"
Output: 0
Explanation: "06" cannot be mapped to "F" because of the leading zero ("6" is different from "06").
```



Code

Type 1

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413. Arithmetic Slices

Medium Topics Companies

An integer array is called arithmetic if it consists of **at least three elements** and if the difference between any two consecutive elements is the same.

- For example, `[1,3,5,7,9]`, `[7,7,7,7]`, and `[3,-1,-5,-9]` are arithmetic sequences.

Given an integer array `nums`, return *the number of arithmetic* ***subarrays*** *of* `nums`.

A **subarray** is a contiguous subsequence of the array.

Example 1:

```
Input: nums = [1,2,3,4]
Output: 3
Explanation: We have 3 arithmetic slices in nums: [1, 2, 3], [2, 3, 4] and
[1,2,3,4] itself.
```

Example 2:

```
Input: nums = [1]
Output: 0
```

```
int numberOfArithmeticSlices(vector<int>& arr) {
  int n = arr.size();

  int answer = 0;
  vector<int> dp(n, 0);


  for (int i = 2; i < n; ++i) {
    if (arr[i] - arr[i - 1] == arr[i - 1] - arr[i - 2]) {
      dp[i] += 1 + dp[i - 1];
      answer += dp[i];
    }
  }
  return answer;
}
```

1,2,3,4

0 | 0 | 0 | 0

at n = 2 ⇒ 1,2,3 ⇒ DP[2] = 1

at n = 3 ⇒ 2,3,4 ⇒ DP[3] 1+

ans = sum DP

Type 2 [array + Target]

- المسائل دى بتتحل 2d array / 1d array

* 1d array ⇒ كل شوية هتلاقى هل ممكن على الى واقف عليه؟ لحد ما توصل لـ Target

حلول متغيرك فى المستقبل

متطلع العلاقة من مين

1,2,3

عندك نوعين

1

هتقف فى

① at DP[2] → 1,2

at DP[5] → 1,2,3,4,5

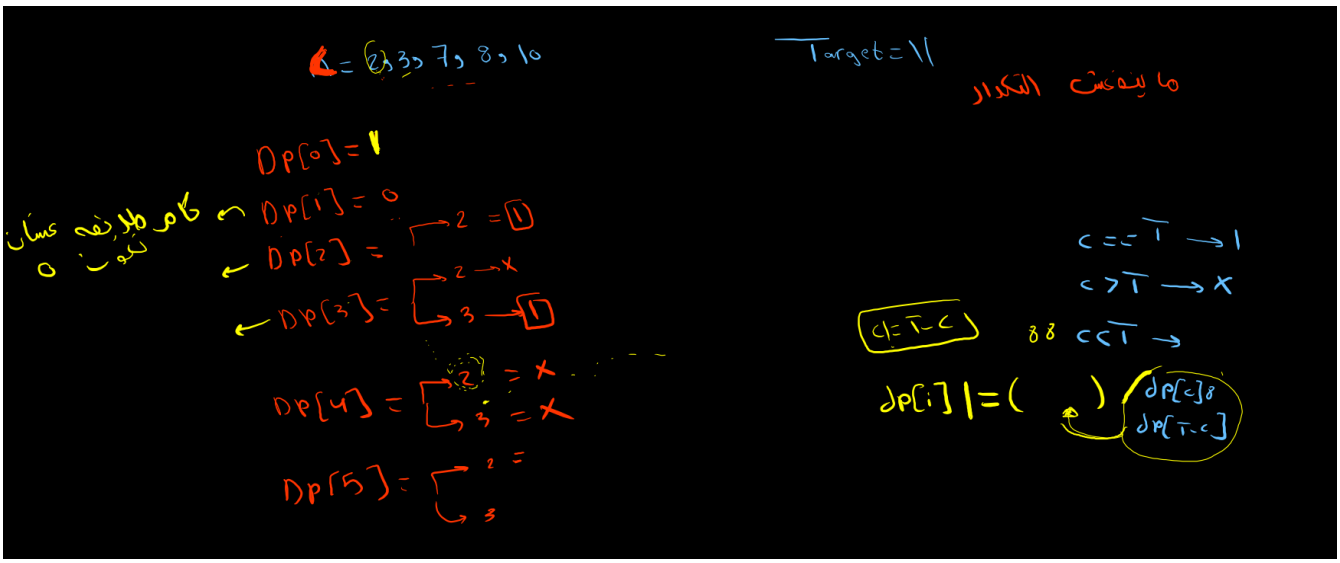
② ... → منفسيه على DP ما وبعدها C2

DP[0] =

DP[1] =

DP[2] =

DP[3] =



Code

322. Coin Change

Medium | Topics | Companies

You are given an integer array `coins` representing coins of different denominations and an integer `amount` representing a total amount of money.

Return *the fewest number of coins that you need to make up that amount*. If that amount of money cannot be made up by any combination of the coins, return `-1`.

You may assume that you have an infinite number of each kind of coin.

Example 1:

> **Input:** coins = [1,2,5], amount = 11
> **Output:** 3
> **Explanation:** 11 = 5 + 5 + 1

Example 2:

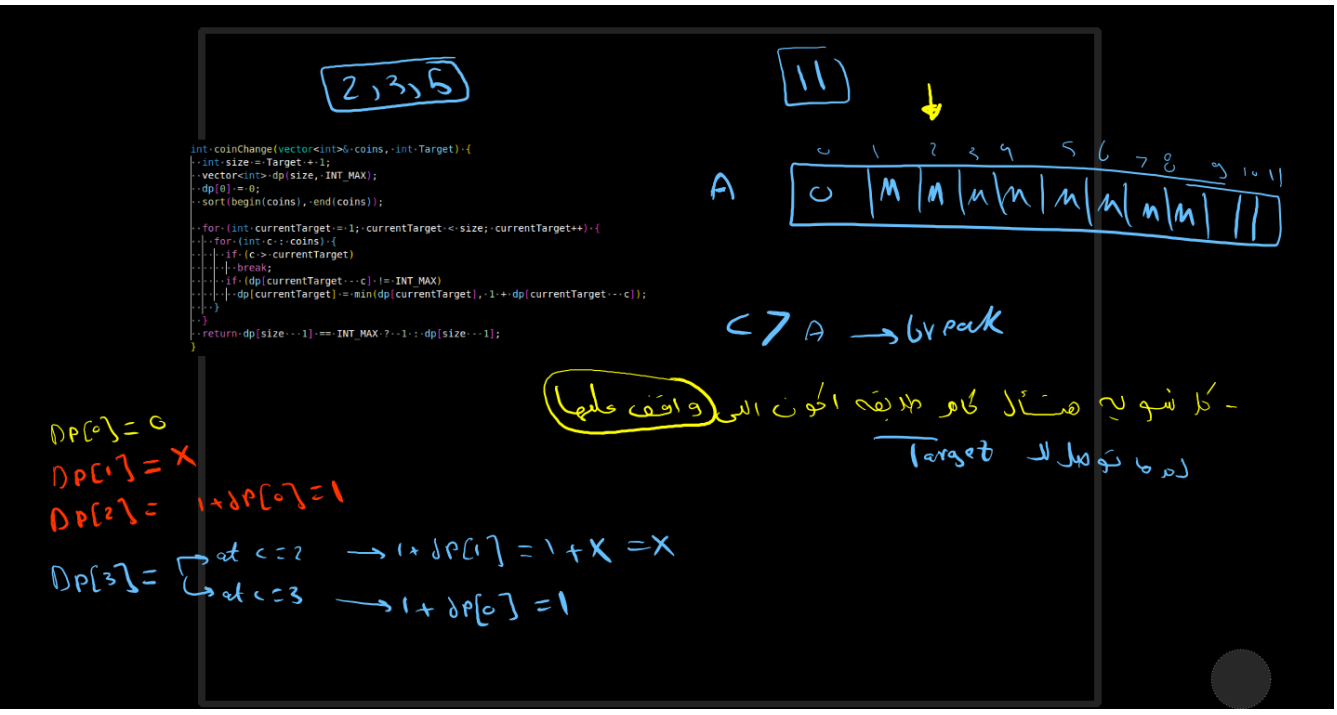
> **Input:** coins = [2], amount = 3
> **Output:** -1

Example 3:

> **Input:** coins = [1], amount = 0
> **Output:** 0

Constraints:

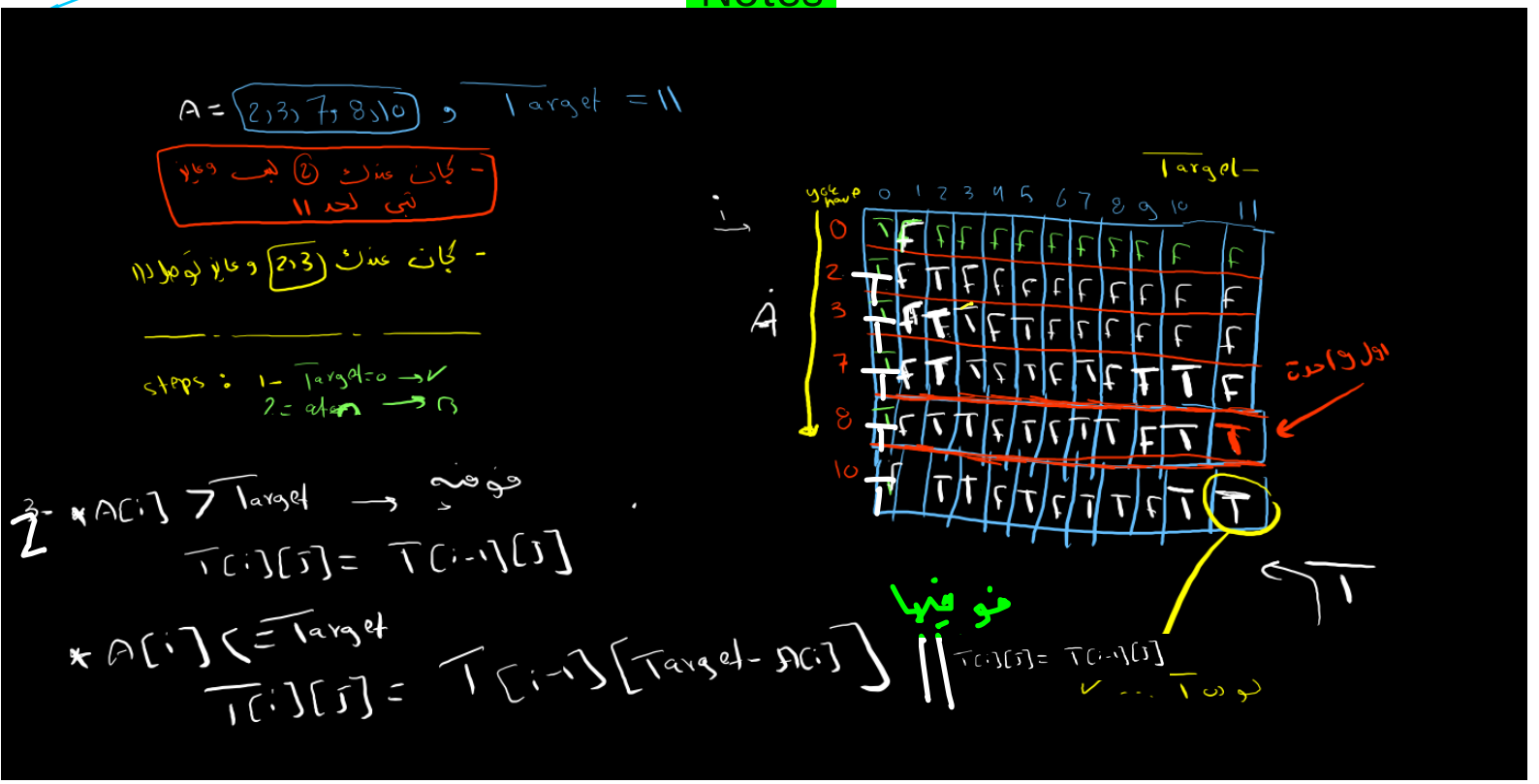
- `1 <= coins.length <= 12`
- `1 <= coins[i] <= 2^31 - 1`
- `0 <= amount <= 10^4`



Code :

Target [array + Target]

Notes



Code

ExtraNotes :

١- انا + اللي معايا = T ← احتمال جديد

٢- ازاى تحدق subset

T فوق T ← اطلع

else ← A ← دوج فوق عندك Target - A =

Type 2

416. Partition Equal Subset Sum

Medium | Topics | Companies

Given an integer array `nums`, return `true` *if you can partition the array into two subsets such that the sum of the elements in both subsets is equal or* `false` *otherwise.*

Example 1:

> **Input:** nums = [1,5,11,5]
> **Output:** true
> **Explanation:** The array can be partitioned as [1, 5, 5] and [11].

Example 2:

> **Input:** nums = [1,2,3,5]
> **Output:** false
> **Explanation:** The array cannot be partitioned into equal sum subsets.

-- 2 parition ==> sum/2
target = sum/2
then : array+target .. if true ..then tmaam

7]

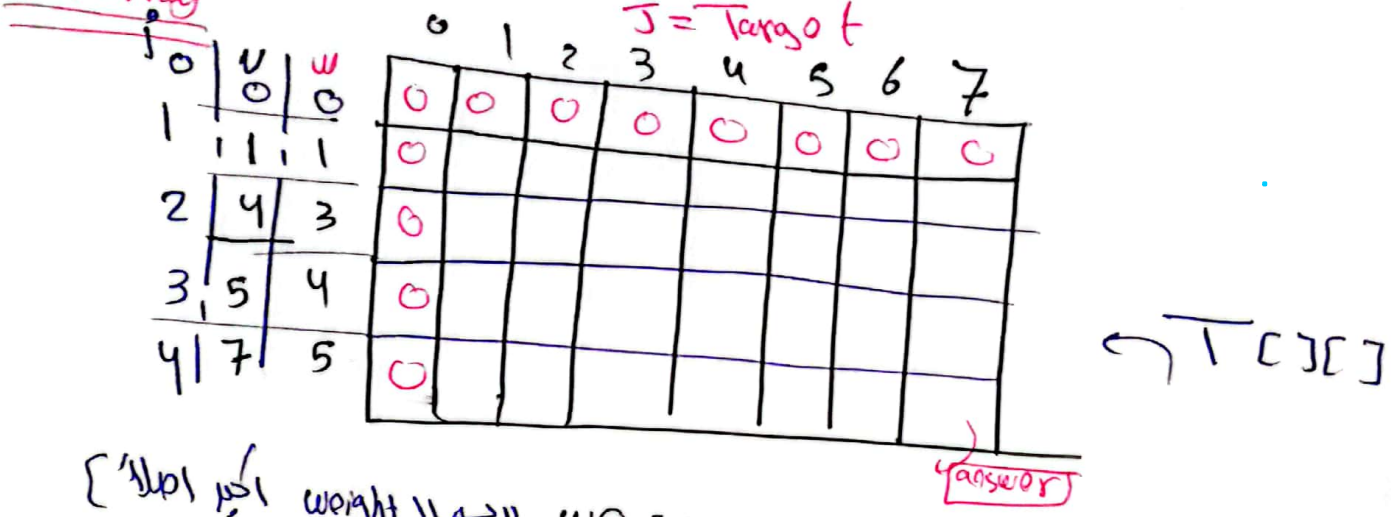
Q] knapsack 0/1 , weight = {1, 3, 4, 5}

Value = {1, 4, 5, 7}

what is The max value of weight = 7 ?

Type 3

2-D array



T[ ][ ]

$w[i-1] > J$ "سوال weight اكبر اصلا" ⇐ cell cell هنفضى

$T[i-1][J]$ يعني خد اللى فوقيها

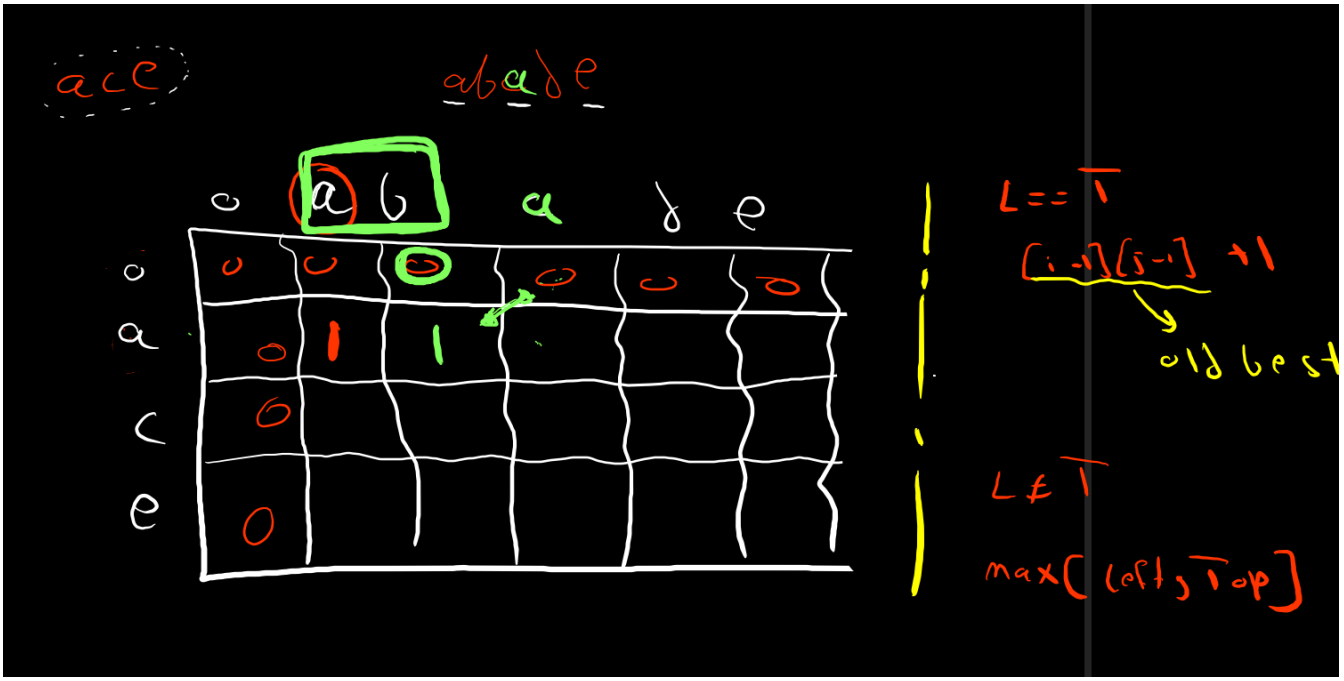
else ⇒ max (v[i-1] + هنعى , فوقيها)

$= \max(v[i-1] + T[i-1][J-w[i-1]] , T[i-1][J])$

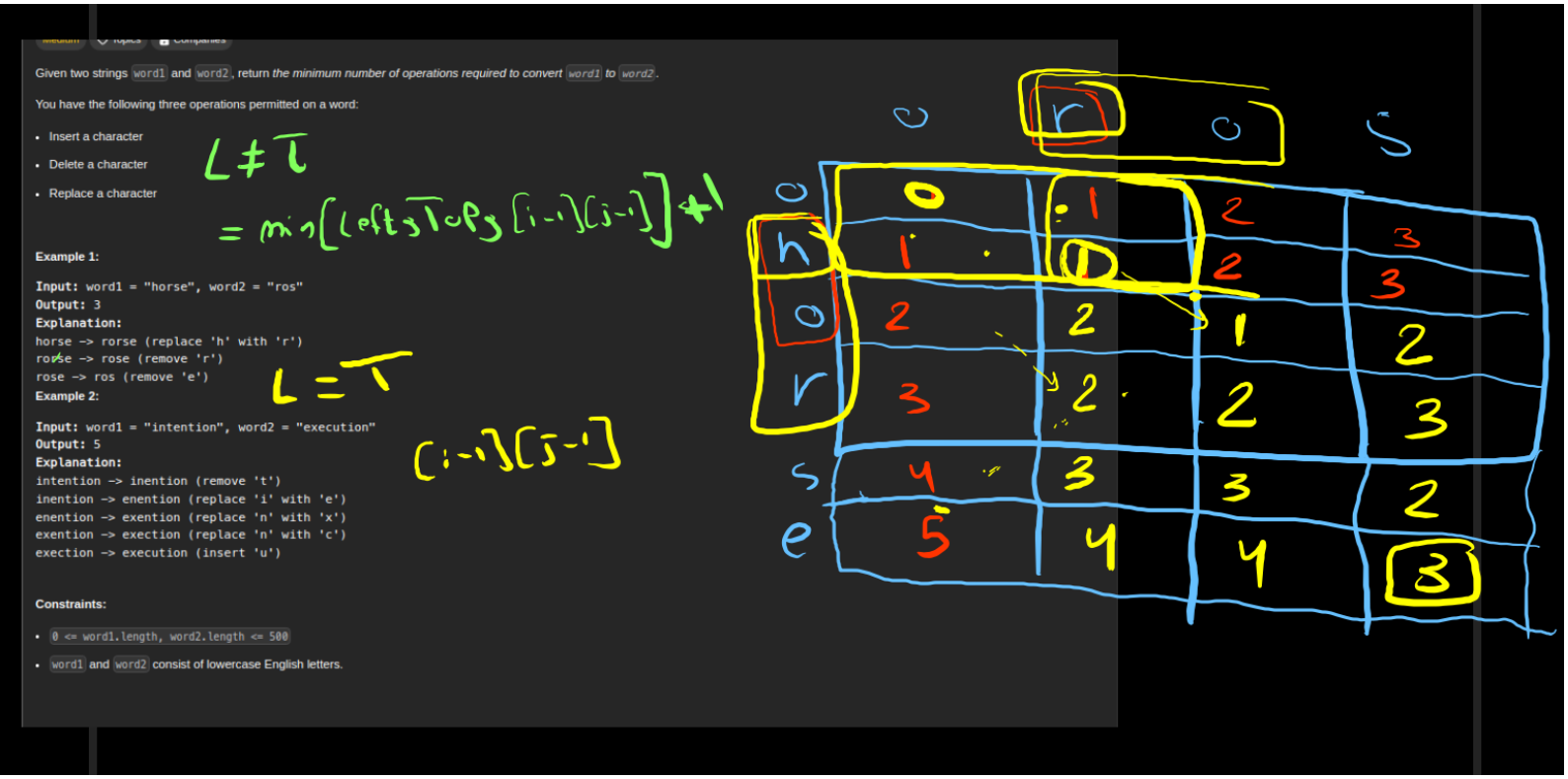
code

Knapsack 0/1 ⇒ ناخد الحبة بالاً وماتهمناش ناخدها اكتر من مرة

Type 4 : abcdef } acbef } find Longest common Subsequence



Code :



Code :

10. Regular Expression Matching

Solved

Hard | Topics | Companies

Given an input string `s` and a pattern `p`, implement regular expression matching with support for `'.'` and `'*'` where:

- `'.'` Matches any single character.
- `'*'` Matches zero or more of the preceding element.

The matching should cover the **entire** input string (not partial).

Example 1:

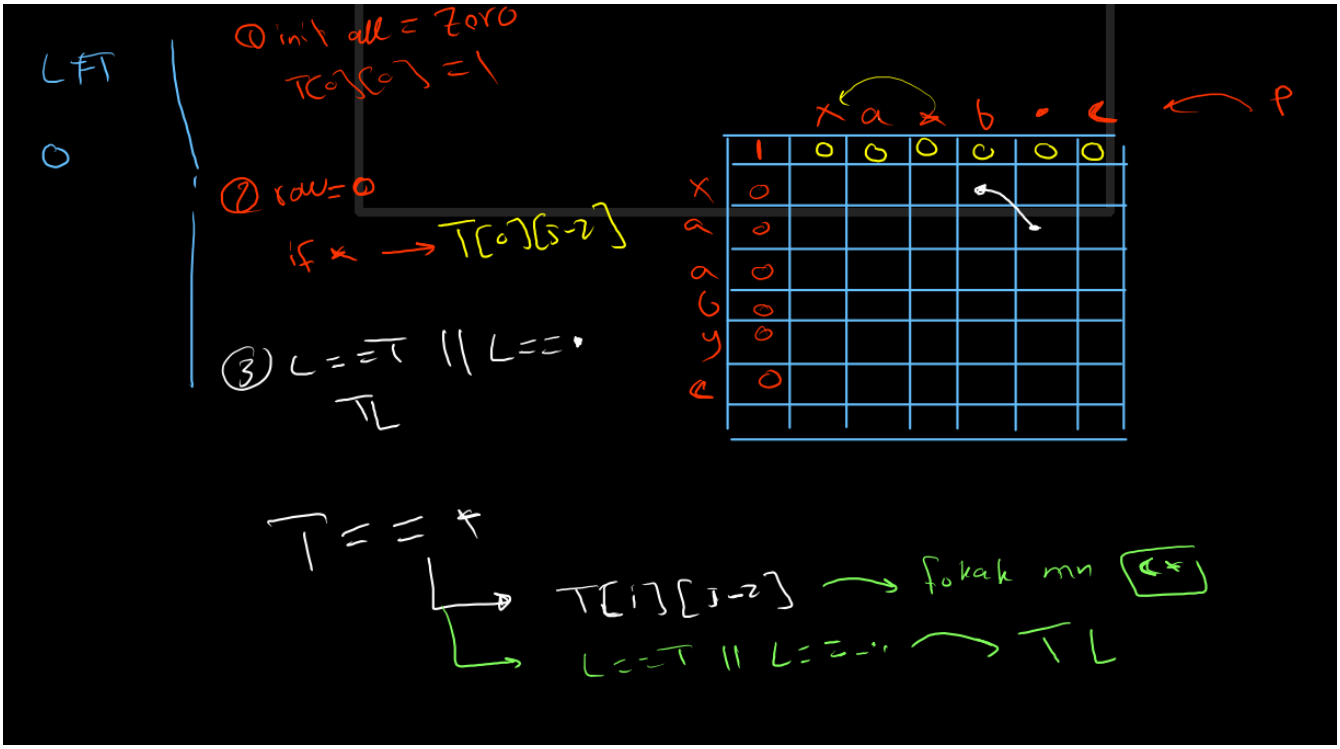
```
Input: s = "aa", p = "a"
Output: false
Explanation: "a" does not match the entire string "aa".
```

Example 2:

```
Input: s = "aa", p = "a*"
Output: true
Explanation: '*' means zero or more of the preceding element, 'a'. Therefore, by repeating 'a' once, it becomes "aa".
```

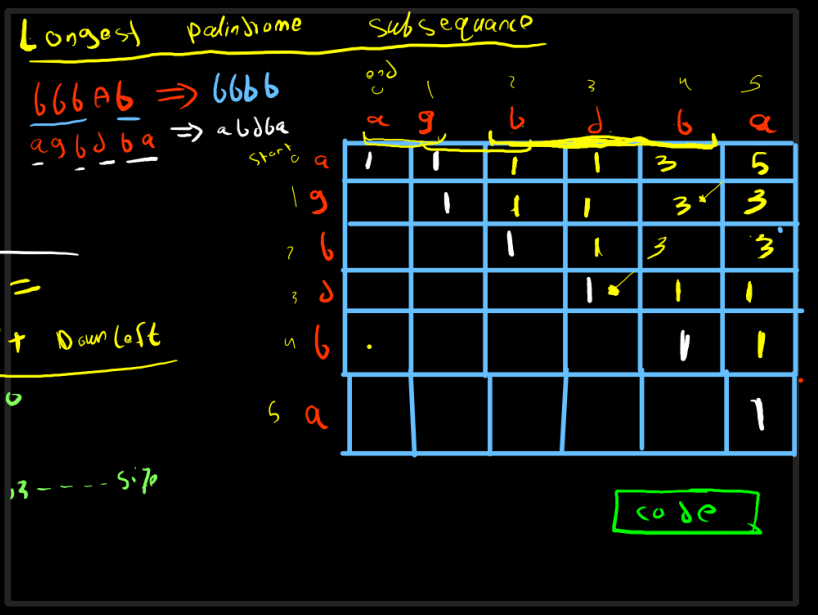
Example 3:

```
Input: s = "ab", p = ".*"
Output: true
Explanation: ".*" means "zero or more (*) of any character (.)".
```



CODE

Type 4


Longest palindrome subsequance
66A6 ⇒ 666
agbdba ⇒ abdba
L=1
≠
=
2+ Down left
① initial = 0
②
③
code