Longest common substring

The longest common substring problem is the problem of finding the longest string (or strings) that is a substring of two strings

eg: S_1 = "ABABC" S_2 = "BABCA"

method 1

Consider all substrings of 2nd string and find the longest substring that is also a substring of first string

$$O((m+n) * m^2)$$

method 2

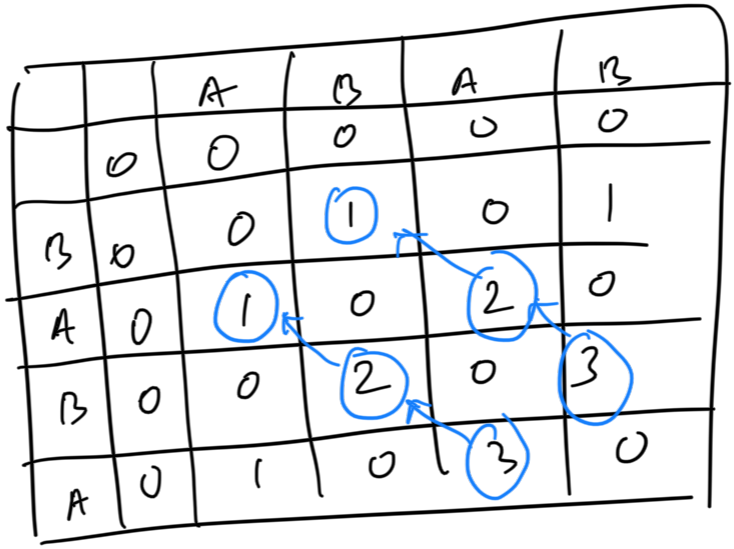
Dynamic Programming

$$LCS[i][j] = \begin{cases} 1 + LCS[i-1][j-1] & \text{if } X[i-1] = Y[j-1] \\ 0 & \text{else} \end{cases}$$

		A	B	A	B
	0	0	0	0	0
B	0	0	0+1=1	0	0+1=1
A	0	0+1=1	0	1+1=2	0
B	0	0	1+1=2	0	2+1=3
A	0	0+1=1	0	2+1=3	0

To Backtrack

Find max number in matrix
and diagonally do backward
fill we get 0



			A	B	A	B
		0	0	0	0	0
B	0	0	0	1	0	1
A	0	1	0	2	0	
B	0	0	2	0	3	
A	0	1	0	3	0	

ABA , BAB

These 2 are longest common substring.

memo = [m+1] [n+1] initialize all with 0 boxes

```
For i in range (1, m+1):
    for j in range (1, n+1):
        if X[i-1] = Y[j-1]:
            memo[i][j] = 1 + memo[i-1][j-1]
        else
            memo[i][j] = 0
```

O(m) O(n) O(1) O(m·n)

OPTIMAL ANS

```
temp = max (memo)
```

FOR OPTIMAL SOLUTION

```
pos = position of temp = (i, j)
ans = [ ]
ans.append (memo[i][j])
For K in range (temp):
    i = i-1
    j = j-1
    ans.append (memo[i-1][j-1])
```

Time complexity O(m·n)

space complexity $O(m \cdot n)$