# **Number of Subsequences (DP exercise)**

### <u>Problem</u>

You are given a string s consisting of lowercase letters latin letters ('a' to 'z') and some '?'. Your task is to find the number of subsequences 'abc' in all the strings. '?' should be replaced by either of {'a', 'b', 'c'}.

### Example

ac?b?c

Possible Strings	Number of Subsequences 'abc'		
acabac	2		
acabbc	4		
acabcc	4		
acbbac	2		
acbbbc	3		
acbbcc	4		
accbac	1		
accbbc	2		
accbcc	2		
Total	24		

# Brute force approach

## Optimal Approach (Using dynamic programming)

Declare 4 variables,

- A. e denoting count of all possible strings upto current element.
- B. a denoting count of subsequences ('a') in all the strings upto current elements.
- C. ab denoting count of subsequences ('ab') in all the strings upto current element.
- D. abc denoting count of subsequences ('abc') in all the strings upto current element.

According to this table, update the above variables while iterating in the string.

Current Element	е	а	ab	abc	
"a"	(e)	(a) + e	(ab)	(abc)	
"b"	(e)	(a)	(ab) + (a)	(abc)	
"c"	(e)	e) (a) (ab)		(abc) + (ab)	
"d-z"	(e)	(a)	(ab)	(abc)	
"?"	3*(e)	3*(a)+e	3*(ab)+(a)	3*(abc)+(ab)	

### Dry Run

Variables	Current element	'a'	'c'	<b>,</b> 5,	ʻb'	' <u>'</u> '	·ς`
е	1	1	1	3	3	9	9
а	0	1	1	4	4	15	15
ab	0	0	0	1	5	19	19
abc	0	0	0	0	0	5	24