

String Permutations by changing case (medium)

We'll cover the following ^

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 - Time complexity
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Problem Statement

Given a string, find all of its permutations preserving the character sequence but changing case.

Example 1:

```
Input: "ad52"
Output: "ad52", "Ad52", "aD52", "AD52"
```

Example 2:


```
Input: "ab7c"
Output: "ab7c", "Ab7c", "aB7c", "AB7c", "ab7C", "Ab7C", "aB7C", "AB7C"
```

Try it yourself

Try solving this question here:

 Java

 Python3

 JS


 C++

```
1 def find_letter_case_string_permutations(str):
2     permutations = []
3     # TODO: Write your code here
4     return permutations
5
6
7 def main():
8     print("String permutations are: " +
9         str(find_letter_case_string_permutations("ad52")))
10    print("String permutations are: " +
11        str(find_letter_case_string_permutations("ab7c")))
12
13
14 main()
15
```

Run

Save

Reset



Solution

This problem follows the [Subsets](#) pattern and can be mapped to [Permutations](#).

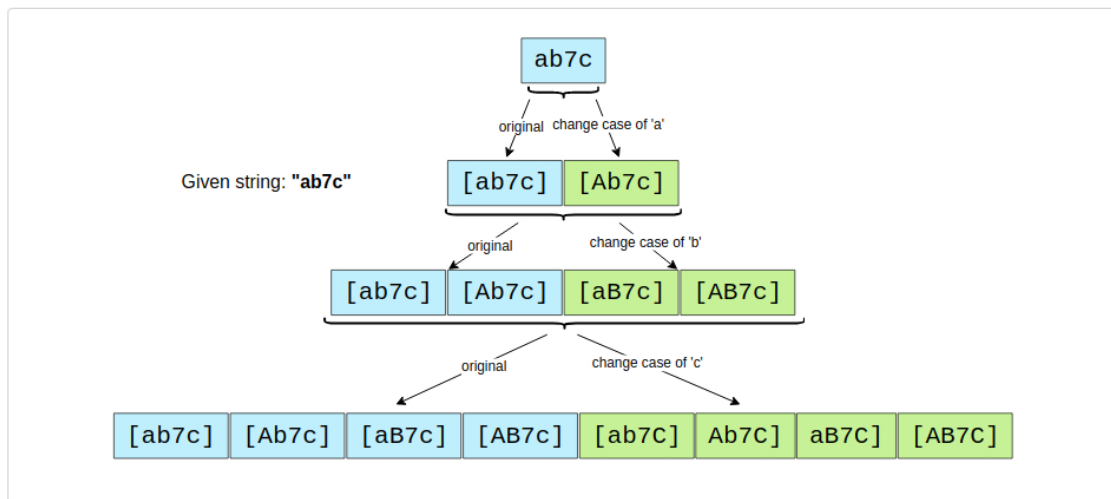
Let's take Example-2 mentioned above to generate all the permutations. Following a **BFS** approach, we will consider one character at a time. Since we need to preserve the character sequence, we can start with the actual string and process each character (i.e., make it upper-case or lower-case) one by one:

1. Starting with the actual string: "ab7c"
2. Processing the first character ('a'), we will get two permutations: "ab7c", "Ab7c"
3. Processing the second character ('b'), we will get four permutations: "ab7c", "Ab7c", "aB7c", "AB7c"
4. Since the third character is a digit, we can skip it.
5. Processing the fourth character ('c'), we will get a total of eight permutations: "ab7c", "Ab7c", "aB7c", "AB7c", "ab7C", "Ab7C", "aB7C", "AB7C"

Let's analyze the permutations in the 3rd and the 5th step. How can we generate the permutations in the 5th step from the permutations in the 3rd step?

If we look closely, we will realize that in the 5th step, when we processed the new character ('c'), we took all the permutations of the previous step (3rd) and changed the case of the letter ('c') in them to create four new permutations.

Here is the visual representation of this algorithm:



Code

Here is what our algorithm will look like:

Java

Python3

C++

JS

```

1 def find_letter_case_string_permutations(str):
2     permutations = []
3     permutations.append(str)
4     # process every character of the string one by one
5     for i in range(len(str)):
6         if str[i].isalpha(): # only process characters, skip digits
7             # we will take all existing permutations and change the letter case appropriately
8             n = len(permutations)
9             for j in range(n):
10                 chs = list(permutations[j])
11                 # if the current character is in upper case, change it to lower case or vice versa
12                 chs[i] = chs[i].swapcase()
13                 permutations.append(''.join(chs))
14
15     return permutations
16
17
18 def main():
19     print("String permutations are: " +
20           str(find_letter_case_string_permutations("ad52")))
21     print("String permutations are: " +
22           str(find_letter_case_string_permutations("ab7c")))
23
24
25 main()
26

```

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Time complexity

Since we can have 2^N permutations at the most and while processing each permutation we convert it into a character array, the overall time complexity of the algorithm will be $O(N * 2^N)$.

Space complexity

All the additional space used by our algorithm is for the output list. Since we can have a total of $O(2^N)$ permutations, the space complexity of our algorithm is $O(N * 2^N)$.

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