

Longest Substring with Same Letters after Replacement (hard)

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Problem Statement

Given a string with lowercase letters only, if you are allowed to **replace no more than 'k' letters** with any letter, find the **length of the longest substring having the same letters** after replacement.

Example 1:

```
Input: String="aabccbb", k=2
Output: 5
Explanation: Replace the two 'c' with 'b' to have a longest repeating substring "bbbbb".
```

Example 2:

```
Input: String="abbcb", k=1
Output: 4
Explanation: Replace the 'c' with 'b' to have a longest repeating substring "bbbb".
```

Example 3:

```
Input: String="abccde", k=1
Output: 3
Explanation: Replace the 'b' or 'd' with 'c' to have the longest repeating substring "ccc".
```

Try it yourself

Try solving this question here:

JavaPython3JSC++

```
1 class CharacterReplacement {
2     public static int findLength(String str, int k) {
3         // TODO: Write your code here
4         return -1;
5     }
6 }
7
```

TestSaveReset

Solution

This problem follows the **Sliding Window** pattern, and we can use a similar dynamic sliding window strategy as discussed in [No-repeat Substring](#). We can use a HashMap to count the frequency of each letter.

- We'll iterate through the string to add one letter at a time in the window.
- We'll also keep track of the count of the maximum repeating letter in **any** window (let's call it `maxRepeatLetterCount`).
- So, at any time, we know that we can have a window which has one letter repeating `maxRepeatLetterCount` times; this means we should try to replace the remaining letters.
- If we have more than 'k' remaining letters, we should shrink the window as we are not allowed to replace more than 'k' letters.

While shrinking the window, we don't need to update `maxRepeatLetterCount` (which makes it global count; hence, it is the maximum count for ANY window). Why don't we need to update this count when we shrink the window? The answer: In any window, since we have to replace all the remaining letters to get the longest

substring having the same letter, we can't get a better answer from any other window even though all occurrences of the letter with frequency `maxRepeatLetterCount` is not in the current window.

Code

Here is what our algorithm will look like:

Java Python3 C++ JS

```
1 import java.util.*;
2
3 class CharacterReplacement {
4     public static int findLength(String str, int k) {
5         int windowStart = 0, maxLength = 0, maxRepeatLetterCount = 0;
6         Map<Character, Integer> letterFrequencyMap = new HashMap<>();
7         // try to extend the range [windowStart, windowEnd]
8         for (int windowEnd = 0; windowEnd < str.length(); windowEnd++) {
9             char rightChar = str.charAt(windowEnd);
10            letterFrequencyMap.put(rightChar, letterFrequencyMap.getOrDefault(rightChar, 0) + 1);
11            maxRepeatLetterCount = Math.max(maxRepeatLetterCount, letterFrequencyMap.get(rightChar));
12
13            // current window size is from windowStart to windowEnd, overall we have a letter which is
14            // repeating 'maxRepeatLetterCount' times, this means we can have a window which has one letter
15            // repeating 'maxRepeatLetterCount' times and the remaining letters we should replace.
16            // if the remaining letters are more than 'k', it is the time to shrink the window as we
17            // are not allowed to replace more than 'k' letters
18            if (windowEnd - windowStart + 1 - maxRepeatLetterCount > k) {
19                char leftChar = str.charAt(windowStart);
20                letterFrequencyMap.put(leftChar, letterFrequencyMap.get(leftChar) - 1);
21                windowStart++;
22            }
23
24            maxLength = Math.max(maxLength, windowEnd - windowStart + 1);
25        }
26
27        return maxLength;
28    }
29 }
```

Run Save Reset

Time Complexity

The above algorithm's time complexity will be $O(N)$, where 'N' is the number of letters in the input string.

Space Complexity

As we expect only the lower case letters in the input string, we can conclude that the space complexity will be $O(26)$ to store each letter's frequency in the **HashMap**, which is asymptotically equal to $O(1)$.

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✓ Completed

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