Rearrange String (hard)

Problem Statement

Given a string, find if its letters can be rearranged in such a way that no two same characters come next to each other.

Example 1:

```
Input: "aappp"
Output: "papap"
Explanation: In "papap", none of the repeating characters come next to each other.
```

Example 2:

```
Input: "Programming"
Output: "rgmrgmPiano" or "gmringmrPoa" or "gmrPagimnor", etc.
Explanation: None of the repeating characters come next to each other.
```

Example 3:

```
Input: "aapa"
Output: ""
Explanation: In all arrangements of "aapa", atleast two 'a' will come together e.g., "apaa", "p
aaa".
```

Try it yourself

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```
const rearrange_string = function(str) {
  // TODO: Write your code here
  return "";
};


console.log(`Rearranged string: ${rearrange_string("aappp")}`)
console.log(`Rearranged string: ${rearrange_string("Programming")}`)
console.log(`Rearranged string: ${rearrange_string("aapa")}`)
```

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Solution

This problem follows the Top 'K' Numbers pattern. We can follow a greedy approach to find an arrangement of the given string where no two same characters come next to each other.

We can work in a stepwise fashion to create a string with all characters from the input string. Following a greedy approach, we should first append the most frequent characters to the output strings, for which we can use a **Max Heap**. By appending the most frequent character first, we have the best chance to find a string where no two same characters come next to each other.

So in each step, we should append one occurrence of the highest frequency character to the output string. We will not put this character back in the heap to ensure that no two same characters are adjacent to each other. In the next step, we should process the next most frequent character from the heap in the same way and then, at the end of this step, insert the character from the previous step back to the heap after decrementing its frequency.

Following this algorithm, if we can append all the characters from the input string to the output string, we would have successfully found an arrangement of the given string where no two same characters appeared adjacent to each other.

Code

Here is what our algorithm will look like:

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```
    maxHeap.push([charFrequencyMap[char], char]);
  });

  let previousChar = null,
    previousFrequency = 0,
    resultString = [];
  while (maxHeap.length > 0) {
    const [frequency, char] = maxHeap.pop();
    // add the previous entry back in the heap if its frequency is greater than zero
    if (previousChar !== null && previousFrequency > 0) {
      maxHeap.push([previousFrequency, previousChar]);
    }
    // append the current character to the result string and decrement its count
    resultString.push(char);
    previousChar = char;
    previousFrequency = frequency - 1; // decrement the frequency
  }

  // if we were successful in appending all the characters to the result string, return it
  if (resultString.length === str.length) {
    return resultString.join('');
  }
  return '';
}


console.log(`Rearranged string:  ${rearrange_string('aappp')}`);
console.log(`Rearranged string:  ${rearrange_string('Programming')}`);
```

RUN SAVE RESET

Close

Output 13.044s

```
Rearranged string:  papap
Rearranged string:  rgmrgmoaPin
Rearranged string:
```

Time complexity

The time complexity of the above algorithm is $O(N*logN)$ where 'N' is the number of characters in the input string.

Space complexity

The space complexity will be $O(N)$, as in the worst case, we need to store all the 'N' characters in the **HashMap**.

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