

# Optimal String Hackerrank Solution



Optimal string hackerrank solution is a common challenge faced by programmers who want to improve their coding skills, particularly in string manipulation and optimization. HackerRank, a popular platform for coding challenges and competitions, presents various problems that require creative and efficient solutions. Among these, the optimal string problem stands out, testing the coder's ability to manipulate strings with both precision and efficiency. In this article, we will break down the problem, explore different approaches to solve it, and finally arrive at the optimal solution.

## Understanding the Optimal String Problem

The optimal string problem generally asks you to determine how many characters need to be removed from a string to make it a valid palindrome. A palindrome is a string that reads the same forwards and backwards, such as "racecar" or "madam". The challenge lies in figuring out the minimum number of deletions required.

## Problem Statement

Given a string, you are to compute the minimum number of deletions required to make the string a palindrome. For example:

- Input: "abc"
- Output: 2 (You can remove 'a' and 'b' to get "c", or 'b' and 'c' to get "a", or 'a' and 'c' to get "b".)

## Constraints

- The string can contain uppercase and lowercase letters.
- The length of the string can go up to 1000 characters.

## Analyzing the Problem

To devise an optimal solution, we need to understand the properties of palindromes. A string is a palindrome if its first half mirrors its second half. Therefore, our goal is to find the longest palindromic subsequence (LPS) in the string. The minimum number of deletions required to make the string a

palindrome is equal to the length of the string minus the length of the LPS.

## Key Concepts

1. Longest Palindromic Subsequence (LPS): This is the longest sequence that can be derived from the string, which is also a palindrome. For example, for the string "character", the LPS is "carac".
2. Dynamic Programming (DP): This technique is particularly useful for solving problems involving optimization and sub-problems. We can break down the problem of finding the LPS into smaller sub-problems.

## Dynamic Programming Approach

To find the LPS, we can use a dynamic programming approach which involves the following steps:

### Step 1: Create a DP Table

We will create a 2D array (dp) where  $dp[i][j]$  will represent the length of the longest palindromic subsequence in the substring from index  $i$  to  $j$ .

### Step 2: Initialize the Table

1. If the substring has a length of one (i.e.,  $i == j$ ), then  $dp[i][j] = 1$  because a single character is a palindrome.
2. If the substring length is two (i.e.,  $j == i + 1$ ):
  - If the characters are the same,  $dp[i][j] = 2$ .
  - If they are different,  $dp[i][j] = 1$ .

### Step 3: Fill the DP Table

Using a bottom-up approach:

- Start with substrings of length 3 up to the length of the string.
- For each substring, check the characters at the beginning and end:
  - If they are the same, then  $dp[i][j] = dp[i + 1][j - 1] + 2$ .
  - If they are different, then  $dp[i][j] = \max(dp[i + 1][j], dp[i][j - 1])$ .

### Step 4: Calculate Minimum Deletions

Finally, the minimum number of deletions required to make the string a palindrome will be:

$$\text{Minimum Deletions} = \text{Length of string} - \text{Length of LPS}$$

## Python Implementation

Here's a Python implementation of the above approach:

```
```python
def min_deletions_to_palindrome(s):
    n = len(s)
    dp = [[0] * n for _ in range(n)]
```

Fill the DP table

```

for i in range(n):
    dp[i][i] = 1 Single character is a palindrome

for length in range(2, n + 1): Length of the substring
    for i in range(n - length + 1):
        j = i + length - 1
        if s[i] == s[j]:
            dp[i][j] = dp[i + 1][j - 1] + 2
        else:
            dp[i][j] = max(dp[i + 1][j], dp[i][j - 1])

length_of_lps = dp[0][n - 1]
return n - length_of_lps

```

#### Example Usage

```

input_string = "abc"
print(min_deletions_to_palindrome(input_string)) Output: 2
```

```

#### Complexity Analysis

##### Time Complexity

The time complexity of this dynamic programming solution is  $O(n^2)$ , where  $n$  is the length of the string. This is due to the nested loops that fill the DP table.

##### Space Complexity

The space complexity is also  $O(n^2)$  because we are using a 2D array to store the lengths of the longest palindromic subsequences.

#### Conclusion

The optimal string hackerrank solution for the problem of determining the minimum number of deletions to make a string a palindrome can be efficiently solved using dynamic programming. By leveraging the concept of the longest palindromic subsequence, we can break down the problem into manageable parts. This approach not only provides a clear path to the solution but also enhances our understanding of string manipulation and optimization techniques.

In a broader context, mastering such algorithms is crucial for anyone looking to excel in competitive programming or software development. Each challenge like this on platforms such as HackerRank hones problem-solving skills and prepares you for real-world coding scenarios.

## Frequently Asked Questions

### What is the optimal approach to solve the 'Optimal String'

## **problem on HackerRank?**

The optimal approach is to use a greedy algorithm to calculate the maximum possible score by iterating through the string and maintaining a count of characters while using a frequency array to ensure that each character contributes optimally.

## **What data structure is most effective for keeping track of character frequencies in the 'Optimal String' problem?**

A frequency array or a hash map is most effective for keeping track of character frequencies, as it allows for  $O(1)$  access and updates to the counts of characters.

## **How does the 'Optimal String' problem evaluate the score of a string?**

The score of a string is evaluated based on the frequency of characters, where each unique character contributes to the score based on its occurrence and position in the string.

## **What is the time complexity of the optimal solution for the 'Optimal String' problem?**

The time complexity of the optimal solution is  $O(n)$ , where  $n$  is the length of the string, as it requires a single pass to count characters and another pass to calculate the score.

## **Are there any edge cases to consider while solving the 'Optimal String' problem?**

Yes, edge cases include strings with all identical characters, empty strings, and strings with a mix of upper and lower case letters, which may affect scoring based on the problem constraints.

## **How can I optimize my solution further if I am facing performance issues with the 'Optimal String' problem?**

You can optimize your solution by minimizing space complexity, reusing data structures, and avoiding unnecessary computations or loops, ensuring you only traverse the string and character arrays once.

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