# Strings – Reverse a String

## 1. Introduction

**Reversing a string** means changing the order of characters so that the **last character becomes the first** and the **first becomes the last**.

It is one of the most fundamental string operations and is widely used in **string manipulation, problem solving, and interview questions**.

## 2. What Does Reversing a String Mean?

Given a string:

```
"CODE"
```

Reversed string:

```
"EDOC"
```

The sequence of characters is flipped **from end to start**.

## 3. Why is String Reversal Important?

Reversing a string is important because:

- It helps understand string traversal
- Used in palindrome checking
- Used in data transformation
- Commonly asked in interviews
- Forms the base for many advanced problems

## 4. Basic Approaches to Reverse a String

There are multiple ways to reverse a string, but conceptually they all rely on **character traversal**.

### Common approaches:

1. Using a loop (backward traversal)
2. Using two-pointer technique
3. Using an extra string or array
4. Using recursion (advanced)

For beginners, **loop-based reversal** is the most important.

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## 5. Logic for Reversing a String (Plain English)

### Method 1: Reverse Traversal

1. Start from the last character of the string
2. Move backward character by character
3. Store or print each character
4. Continue until the first character is reached

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## 6. Visualization of String Reversal

Original string:

```
"HELLO"
```

Traversal order:

```
O → L → L → E → H
```

Reversed string:

```
"OLLEH"
```

A pointer moves **from right to left**, collecting characters.

## 7. Two-Pointer Technique (Conceptual)

- One pointer starts at the beginning
- Another pointer starts at the end
- Characters are swapped
- Pointers move toward the center

This method is efficient and commonly used.

## 8. Time and Space Complexity

| **Aspect** | **Complexity** |
|---|---|
| Time Complexity | O(n) |
| Space Complexity | O(1) or O(n) (depending on method) |

- O(1) when reversing in place
- O(n) when using an extra string

## 9. Special Cases

- **Empty string:** Result is empty
- **Single character:** Same string
- **Palindrome string:** Reversal remains same

## 10. Real-World Applications

- Palindrome checking
- Text processing
- Data validation
- Encoding and decoding

- Word games and puzzles

## 11. Common Problems Related to String Reversal

- Reverse words in a sentence
- Check if string is palindrome
- Reverse only vowels
- Reverse each word separately
- Reverse string using recursion

## 12. Summary

- Reversing a string changes character order
- It uses traversal from end to start
- Time complexity is O(n)
- It is a fundamental string operation
- Important for interviews and DSA basics