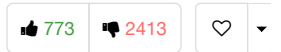


6. ZigZag Conversion

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Solution

Approach 1: Sort by Row

Intuition

By iterating through the string from left to right, we can easily determine which row in the Zig-Zag pattern that a character belongs to.

Algorithm

We can use `min(numRows, len(s))` lists to represent the non-empty rows of the Zig-Zag Pattern.

Iterate through `s` from left to right, appending each character to the appropriate row. The appropriate row can be tracked using two variables: the current row and the current direction.

The current direction changes only when we moved up to the topmost row or moved down to the bottommost row.

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Complexity Analysis

- Time Complexity: $O(n)$, where $n == \text{len}(s)$
- Space Complexity: $O(n)$

Approach 2: Visit by Row

Intuition

Visit the characters in the same order as reading the Zig-Zag pattern line by line.

Algorithm

Visit all characters in row 0 first, then row 1, then row 2, and so on...

For all whole numbers k ,

- Characters in row 0 are located at indexes $k(2 \cdot \text{numRows} - 2)$
- Characters in row $\text{numRows} - 1$ are located at indexes $k(2 \cdot \text{numRows} - 2) + \text{numRows} - 1$
- Characters in inner row i are located at indexes $k(2 \cdot \text{numRows} - 2) + i$ and $(k + 1)(2 \cdot \text{numRows} - 2) - i$.

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Complexity Analysis

- Time Complexity: $O(n)$, where $n == \text{len}(s)$. Each index is visited once.
- Space Complexity: $O(n)$. For the cpp implementation, $O(1)$ if return string is not considered extra space.

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