Day 3: Reverse an Array

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"Simplicity is the soul of efficiency."
— Austin Freeman

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1 Introduction

Reversing an array is a classic problem in computer science that emphasizes in-place manipulation of data to optimize memory usage. In this task, we reverse the array without using any additional arrays, utilizing the two-pointer technique.

2 Problem Statement

Problem: Reverse an array in-place without using an extra array. **Hint:** Use the two-pointer technique to swap the first and last elements, then move the pointers inward until they meet or cross.

3 Algorithm

3.1 Two-Pointer Technique

1. Initialize two pointers:
    - `left` at the beginning of the array.
    - `right` at the end of the array.
2. While `left` is less than `right`:
    - Swap the elements at `left` and `right`.
    - Increment `left` and decrement `right`.
3. Repeat until all elements are reversed.

4 Code

```c
#include <stdio.h>

// Function to reverse an array in-place
void reverseArray(int arr[], int n) {
    int left = 0, right = n - 1;
    while (left < right) {
        // Swap the elements
        int temp = arr[left];
        arr[left] = arr[right];
        arr[right] = temp;

        // Move the pointers inward
        left++;
        right--;
    }
}

int main() {
    int n;
    printf("Enter the size of the array: ");
    scanf("%d", &n);

    int arr[n];
    printf("Enter the elements of the array:\n");
    for (int i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }

    reverseArray(arr, n);

    printf("Reversed Array:\n");
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");

    return 0;
}
```

5 Step-by-Step Explanation of Swaps

1. **Initialization:** Pointers `left` and `right` are set to the first and last indices, respectively.

2. **Iteration 1:**

    - Swap `arr[left]` and `arr[right]`.
    - Move `left` and `right` pointers inward.

3. **Subsequent Iterations:** Continue swapping and moving pointers inward until `left` ≥ `right`.

4. **Completion:** All elements are reversed in-place.

6 Complexity Analysis

6.1 Time Complexity

- The array is traversed once, resulting in a time complexity of $O(n)$.

6.2 Space Complexity

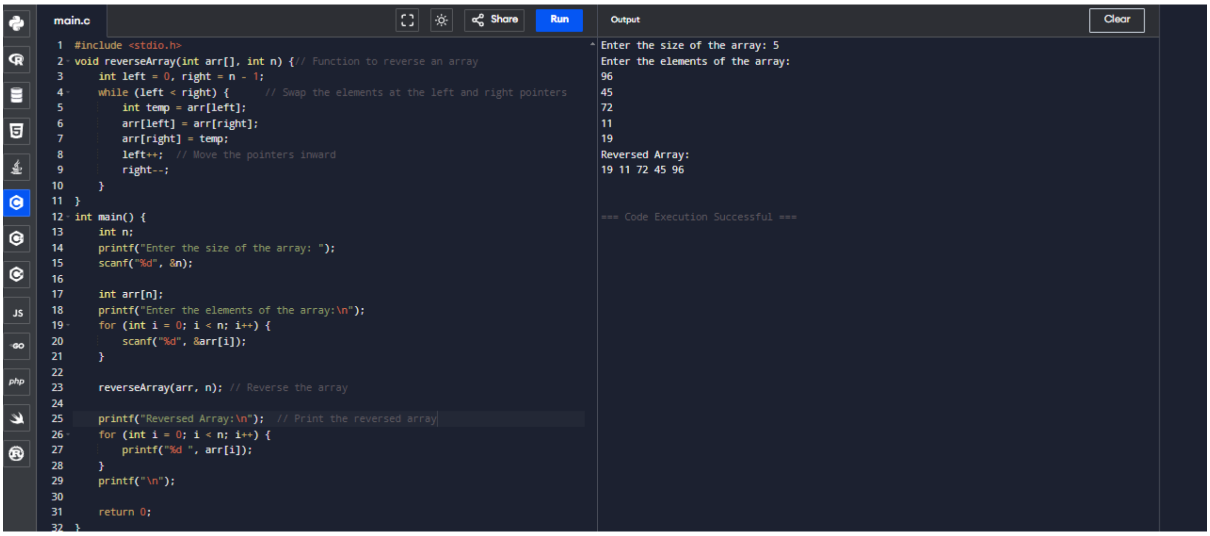
- Since the reversal is done in-place, the space complexity is $O(1)$.

7 Advantages of Two-Pointer Technique

- Reduces memory usage as no extra array is needed.

- Efficiently handles arrays of any size.

8 Output



```c
#include <stdio.h>
void reverseArray(int arr[], int n) {// Function to reverse an array
    int left = 0, right = n - 1;
    while (left < right) {       // Swap the elements at the left and right pointers
        int temp = arr[left];
        arr[left] = arr[right];
        arr[right] = temp;
        left++;  // Move the pointers inward
        right--;
    }
}
int main() {
    int n;
    printf("Enter the size of the array: ");
    scanf("%d", &n);

    int arr[n];
    printf("Enter the elements of the array:\n");
    for (int i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }

    reverseArray(arr, n); // Reverse the array

    printf("Reversed Array:\n");  // Print the reversed array
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");

    return 0;
}
```

```
Enter the size of the array: 5
Enter the elements of the array:
96
45
72
11
19
Reversed Array:
19 11 72 45 96


=== Code Execution Successful ===
```

Figure 1: Output in online compiler

9 Conclusion

The two-pointer technique effectively reverses an array in-place, minimizing memory usage and ensuring simplicity in implementation. This approach is ideal for scenarios where memory is constrained.