Problem of the Week – Swap Even and Odd Bits

Company: Cisco
Difficulty: Medium
Topic: Bit Manipulation

📌 Scenario

In computer systems, efficient bitwise operations are widely used in networking, cryptography, and compression algorithms.

Cisco is testing your bit manipulation skills. You are given an **unsigned 8-bit integer**, and your task is to **swap every even-positioned bit with the adjacent odd-positioned bit**.

- Bits are counted from the right, starting at position 1.
- Example:
  - `10101010` ⟶ `01010101`
  - `11100010` ⟶ `11010001`

📌 Problem Statement

Write a program that takes an unsigned 8-bit integer and returns the integer after swapping each pair of even and odd bits.

Bonus: Can you solve this problem in **one line** using bitwise operations?

🔷 Input Format

- A single integer `n` ($0 \leq n \leq 255$).

🔷 Output Format

- An integer after swapping even and odd bits.

🔷 Example

Sample Input 0

```
170
```

Sample Output 0

```
85
```

Explanation 0
Binary of `170 = 10101010`.
Swapping even/odd bits → `01010101 = 85`.

Sample Input 1

```
226
```

Sample Output 1

```
209
```

Explanation 1
Binary of `226 = 11100010`.
Swapping even/odd bits → `11010001 = 209`.

🔑 Approaches

1. **Brute Force Bit-by-Bit Swap**
   - Loop through all 8 bits.
   - For each pair `(i, i+1)`, swap values.
   - Time complexity: `O(8)` = constant.
2. **Efficient Bitmasking Approach**
   - Use masks to separate even and odd bits:
     - **Even bit mask (0xAA = 10101010 in binary)** → extracts even-positioned bits.
     - **Odd bit mask (0x55 = 01010101 in binary)** → extracts odd-positioned bits.
   - Shift even bits right and odd bits left, then combine:
   - `((n & 0xAA) >> 1) | ((n & 0x55) << 1)`
   - This gives the result in **one line**.

🔗 Practice Links

- GeeksforGeeks – Swap all odd and even bits
- LeetCode Bit Manipulation Problems