



DAILY PROGRAMMING CHALLENGE



Find the Duplicate Number

You are given an array `arr` containing $n+1$ integers, where each integer is in the range $[1, n]$ inclusive. There is exactly one duplicate number in the array, but it may appear more than once. Your task is to find the duplicate number without modifying the array and using constant extra space.

Input:

An integer array `arr` of size $n+1$, where each element is an integer in the range $[1, n]$.

Example : `arr = [3, 1, 3, 4, 2]`

Output:

Return the duplicate integer present in the array.

Example: Duplicate number: 3

Constraints:

- $1 \leq n \leq 10^5$.
- There is only one duplicate number, but it may appear more than once.
- You must not modify the array (`arr`) or use extra space greater than $O(1)$.
- The time complexity must be $O(n)$.

Test Cases:

1. Test Case 1
Input: `[1, 3, 4, 2, 2]`
Output: 2
2. Test Case 2:
Input: `[3, 1, 3, 4, 2]`
Output: 3
3. Test Case 3:
Input: `[1, 1]`
Output: 1
4. Test Case 4:
Input: `[1, 4, 4, 2, 3]`
Output: 4



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5. Test Case 5:

Input: [1, 2, 3, ..., 99999, 50000]

Output: 50000

Edge Cases:

1. The smallest possible array with $n = 1$ where both elements are the same.
2. Arrays where the duplicate number appears more than twice.