**(Problem) Manipulative Numbers (HackerRank)**

Problem Link: https://www.hackerrank.com/challenges/manipulative-numbers

Topic: Bit Manipulation

Difficulty: 7.5/10

**Problem Statement**:

You are given a list **A** of N numbers: {A1, A2, … , An}

Let **B** {B1, B2, … , Bn} be some rearrangement (permutation) of A.

Find **maximum k**, such that 2k <= min {(B1 XOR B­2), (B2 XOR B3), … , (Bn XORB1)} for atleast one rearrangement of A into B.

**Constraints**:

1 <= n <= 100

0 <= Ai <= 109

**Solution**:

Since we have 2^k = min(…), this means that for every pair of sequential numbers in B, at least one of the **kth** or **higher** bit must be set for **only one of the numbers**.

To demonstrate this, suppose the two alternate no’s are :

100010 (34)

XOR

111001 (57)

========

011011 (27)

In this case, the maximum set bit is the 4th bit, i.e 27 > 24

Now, in order for all the n pairs in B to satisfy a given k, **each pair** should have at least one bit (**higher than k**), which is **set in only one** of the two.

This is possible, if we can find n/2 such numbers and place them alternatively (B1, B3 , … ), Subject to the following condition :

Remove the bits after k for all numbers.

Now, if none of these numbers have more than n/2 copies, then for the current k, there is a permutation possible which satisfies the requirement.

This is so, because if we place the numbers with kth or higher bit set in alternating sequence (B1, B3…), looping back to fill (B2…) after completing the n/2 positions, the only way we can have identical numbers in the same pair, is if we have more than n/2 of that number.

Also, we can only have a case where we have less than n/2 numbers with kth or higher bit set if the qty of zero is more than n/2 (This is due to the bitshifting we did to clear any bits < k)

So, we can iterate for x = 31 to x = 0, and check if x satisfies the condition.

In each iteration, we clear the bits before x, and then count how many of each number is there. If there are more than n/2 of any number, iteration continues, else the answer is x.