[B - Sum vs XOR](https://vjudge.net/problem/HackerRank-sum-vs-xor" \t "_blank)

Given non-negative integer N, find number of non-negative integers X (<=N) such that X ⊕ N = X + N where ⊕ denotes XOR operation

**Input Format**

Single number N

**Constraints**

0 <= N <= 1015

**Output Format**

Print single number representing answer.

**Sample Input 0**

**5**

**Sample Output 0**

**2**

**Explanation 0**

0 + 5 = 0 ⊕ 5 = 5  
2 + 5 = 2 ⊕ 5 = 7

**Sample Input 1**

**10**

**Sample Output 1**

**4**

**Explanation 1**

10 + 0 = 10 ⊕ 0 = 10  
10 + 1 = 10 ⊕ 1 = 11  
10 + 4 = 10 ⊕ 4 = 14  
10 + 5 = 10 ⊕ 5 = 15

Sum vs XOR

Analyzing How Sum Can be Expressed Using XOR

A + B = (A ^ B) + 2 \* (A & B)

**HOW TO GET ABOVE IDENTITY?**

Lets consider two example values of A and B in binary form (8-bit for simplicity)

A = 1110 0110  
B = 1010 1001

Since we also know, any integer can be expressed as sum of powers of 2.  So A and B can also be considered as

A = 1110 0110 = 128 + 64 + 32 + 0 + 0 + 4 + 2 + 0  
B = 1010 1001 = 128 + 0 + 32 + 0 + 8 + 0 + 0 + 1

So A + B can be seen as

A + B = **2 \* 128** + 64 + **2 \* 32** + 8 + 4 + 2 + 1

So only bit positions contributing are the ones which are set either in A or B or Both.  And bits which are set in both are contributing 2 times power of 2.

So we can write it as,

A + B = 2 \* (A & B) + (A ^ B)

As per question, in order to count B (<=A) such that

A + B = (A ^ B)

in Identity, we need find out, for how many B values, the term (A & B) will be 0.  For all such values, above condition will satisfy.

**How to Count Bs (<=A) such that A & B = 0**

Again considering binary pattern of A

A = 1110 0110

All B's will be considered such that they have all 1 BITS of A as 0s.  And wherever A has 0 in its binary pattern, B can have either 1 or 0.

e.g.  All binary patterns possible of B, where ? can have 1 or 0 are the answer.

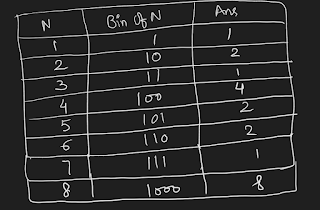
A = 1110 0110  
B = 000? ?00?

If we see, there will be 8 such patterns.  Each question mark has two possibilities - 0  or 1.

Essentially, answer is 2**COUNT OF ZEROES IN BINARY PATTERN OF A**.

Observation with Pen and Paper Workout

Fill out the table below to analyze what is actually answer for each value of N and how it is related to binary form of N?

  
  
Alternatively, we can write brute force code to print answer for every n and then observe pattern using program output.

Here is the code-outline.

int bruteForceAnswer(int n){  
    int c = 0;  
    for(int i = 0; i <=n; i++)  
        if( (n^i) == (n+i))  
             c++;  
    return c;  
}  
void printOutput(){  
     for(int n = 1; n <= 30; n++)  
             print(n, " ", bruteForceAnswer(n), "\n");  
}  
  
printOutput();