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Polite Numbers

In number theory, a polite number is a positive integer that can be written as the sum of two or more consecutive positive integers. Other positive integers are Impolite.

Impolite Numbers

The impolite numbers are exactly the powers of two. It follows from the Lambek-Moser theorem that the n th polite number is $f(n + 1)$, where $f(n) = n + \lfloor \log_2(n + \log_2 n) \rfloor$.

Politeness

The Politeness of a positive number is defined as the number of ways it can be expressed as the sum of consecutive integers. For every x , the politeness of x equals the number of odd divisors of x that are greater than 1.

Polite Forms

All possible polite forms can be printed with $O(\sqrt{N})$ complexity.

The maximum length of a Polite Form of N is $\sqrt{2N}$. Minimum length is 2. By running a loop from minimum length to maximum length, we can find all possible polite forms.

We can find if a Polite Form of N for a particular length exists or not. For example, if we are trying to find Polite Form of length 4 for $N = 15$, it will be $x + (x + 1) + (x + 2) + (x + 3) = 15$. Finding the value of x , if possible, gives us the starting position of a possible Polite Form.

```
///Represent N as polite form of particular length.
///Returns the starting position. -1 if not possible.
int politeForm ( int n, int len ) {
    int sum = ( len * ( len - 1 ) ) / 2;
    int c = n - sum;
    if ( c <= 0 ) return -1;
    if ( c % len != 0 ) return -1;
    return c / len;
}
```

Problems

1. CF 87/C Interesting Game

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