

## 1.6 Problems

### 1.6.1 The $3n + 1$ Problem

**PC/UVa IDs:** 110101/100, **Popularity:** A, **Success rate:** low **Level:** 1

Consider the following algorithm to generate a sequence of numbers. Start with an integer  $n$ . If  $n$  is even, divide by 2. If  $n$  is odd, multiply by 3 and add 1. Repeat this process with the new value of  $n$ , terminating when  $n = 1$ . For example, the following sequence of numbers will be generated for  $n = 22$ :

22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1

It is *conjectured* (but not yet proven) that this algorithm will terminate at  $n = 1$  for every integer  $n$ . Still, the conjecture holds for all integers up to at least 1,000,000.

For an input  $n$ , the *cycle-length* of  $n$  is the number of numbers generated up to and *including* the 1. In the example above, the cycle length of 22 is 16. Given any two numbers  $i$  and  $j$ , you are to determine the maximum cycle length over all numbers between  $i$  and  $j$ , *including* both endpoints.

#### *Input*

The input will consist of a series of pairs of integers  $i$  and  $j$ , one pair of integers per line. All integers will be less than 1,000,000 and greater than 0.

#### *Output*

For each pair of input integers  $i$  and  $j$ , output  $i$ ,  $j$  in the same order in which they appeared in the input and then the maximum cycle length for integers between and including  $i$  and  $j$ . These three numbers should be separated by one space, with all three numbers on one line and with one line of output for each line of input.

#### *Sample Input*

1 10  
100 200  
201 210  
900 1000

#### *Sample Output*

1 10 20  
100 200 125  
201 210 89  
900 1000 174