Xtreme9.0 - Digit Fun!

An editorial, providing an approach to solve this problem, is presented at the bottom of this page.

Recurrence relations are an important tool for the computer scientist. Many algorithms, particularly those that use divide and conquer, have time complexities best modeled by recurrence relations. A recurrence relation allows us to recursively define a sequence of values by defining the n^{th} value in terms of certain of its predecessors.

Many natural functions, such as factorials and the Fibonacci sequence, can easily be expressed as recurrences. The function of interest for this problem is described below.

Let $|A_n|$ denote the number of digits in the decimal representation of A_n. Given any number A_0, we define a sequence using the following recurrence:

$A_i = |A_{i-1}|$ for $i > 0$

The goal of this problem is to determine the smallest positive i such that $A_i = A_{i-1}$.

Input Format

Input consists of multiple lines, each terminated by an end-of-line character. Each line (except the last) contains a value for A_0, where each value is non-negative and no more than a million digits. The last line of input contains the word END.

Output Format

For each value of A_0 given in the input, the program should output one line containing the smallest positive i such that $A_i = A_{i-1}$.

Sample Input

```
9999
0
1
9999999999
END
```

Sample Output

```
3
2
1
4
```

Explanation

The first input value is A_0 = 9999, resulting in A_1 = |9999| = 4. Because 4 does not equal 9999, we find $A_2 = |A_1|$ = |4| = 1. Since 1 is not equal to 4, we find $A_3 = |A_2|$ = |1| = 1. A_3 is equal to A_2, making 3 the smallest positive i such that $A_i = A_{i-1}$.

The second input value is A_0 = 0, resulting in A_1 = |0| = 1. Because 0 does not equal 1, we find $A_2 = |A_1|$ = |1| = 1. A_2 is equal to A_1, making 2 the smallest positive i such that $A_i = A_{i-1}$.

The third input value is A_0 = 1, resulting in A_1 = |1| = 1. A_1 is equal to A_0, making 1 the smallest positive i such that $A_i = A_{i-1}$.

The last input value is A_0 = 9999999999, resulting in A_1 = |9999999999| = 10. Because 10 does not equal 9999999999, we find A_2 = $|A_1|$ = |10| = 2. Since 2 is not equal to 10, we find $A_3 = |A_2|$ = |2| = 1. Since 1 is not equal to 2, we find $A_4 = |A_3|$ = |1| = 1. A_4 is equal to A_3, making 4 the smallest positive i such that $A_i = A_{i-1}$.

Editorial

The following editorial explains an approach for solving this problem.

Given the potential size of the numbers, it is much easier to solve this problem if you attempt to store the values, not in integer variables, but rather as strings.