

Four is the Cosmic Number

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Thirteen, eight, five, four, four is the cosmic number. Twenty-two, ten, three, five, four, four is the cosmic number. If you have not noticed yet, the sequence is generated as follows:

1. Start with a number x
2. Write x in English
3. Count the number of letters in the English word to get the next number
4. Repeat from step 2.

No matter what number we start with, the sequence eventually gets to the number four. Once at four, it stays at four. In other words, four is a stable state. This makes four the cosmic number.

We can quickly check small numbers are not stable states. One and two go to three, three goes to five, six goes to three, ... etc. Also, we can check big numbers always go down really quickly. For example, three-thousand goes to thirteen.

The English way to represent numbers has an encoding of large numbers with few characters. If we let $l(x)$ be the number of letters in the standard encoding of number x in the English language, we can safely assume that for all $x > 20$, $l(x) < x$

We can easily check what happens to the sequence for all values x from 0 to 20. The sequence converges to 4 after a finite number of steps. Therefore, we have shown that for any x , it takes at most $x - 20$ steps to get the value of the sequence to be less than 20. After that, there are finitely many steps of the sequence to get down to 4. It takes $x - 20$ steps since each step will be at most one less than the previous, until we get to twenty. Of course, saying that it takes at most $x - 20$ steps to get the sequence down to 20 is a very crude estimate, but it gets the job done.

We can also analyze what happens in other languages. Lets look at what happens when we read the numbers of in Spanish.

First off, we can make the same assumption as we did in English. We assume that for high enough numbers, the length of encoding is less than the actual value. Thus we just need to see what happens in small numbers.

The first thing we notice is that four is not a stable state, since four is written as “cuatro”, which has six letters. Also, we can see that six, which is written as “seis” goes to four. So if we ever land on 4 or 6, we will stay oscillating between the two values. In fact, 5, written in Spanish as “cinco” is a stable state.

So we have found two possibilities for the eventual behavior of the sequence: either it ends up oscillates between 4 and 6, or it reaches a stable state at 5. The behavior will depend on which numbers we start with.