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The Infinite 9 response
The 3x + 1 Problem aka the Collatz Conjecture Solution

The 3x + 1 problem has been a mystery for over 80 years for anyone to prove or disprove. The conjecture states that if you take an odd positive number, you would multiply it by 3 and then add 1. If it is even number, divide it by 2. Take the resulting answer and then repeat this step, depending on if it is even or odd. Eventually you will get down to 4, then 2, then 1.

The conjecture states that all positive numbers, when you apply the above, will eventually go back down to the 4 2 1 loop. The challenge has been to either 1) find a positive number that does not end up in the 4 2 1 loop or 2) find a positive number that shoots off to infinity. By having it go off to infinity, it will not go back down to the 4 2 1 loop because it will be going up infinitely.

1. **Introduction**: There are multiple websites out there that allow you to easily input a number to see the path it takes and its glide. The glide shows how many steps it takes before getting below the starting point. One of the easier calculators I found to use: http://www.ericr.nl/wondrous/showsteps.html

If you put in a number and hit calculate it will show you how long it will take (the glide) before your starting number gets back below its starting point. For example, if you use the number 27, the glide is 96 because it takes 96 steps to go below 27, the starting point, which is a pretty decent glide. For most numbers, the glide is less than 10.

2. **Sampling and Results:** Using the above calculator, we tested very large numbers and found a pattern that helps to prove that a series of infinite 9's goes to infinity, disproving the Collatz Conjecture. The above calculator program, however is limited, so I created a Java program to help me calculate a gigantic version of this calculator to help prove my results.

Surprisingly, my cat, Smudge, helped me to figure out the answer to this problem as he came and sat on my keyboard and ended up typing a bunch of 9's. I tried it out and we discovered the following results. By doubling the number of 9's you will see that the glide roughly doubles, so as the number of digits of 9 approaches infinity, the glide also approaches infinity. This was a relatively consistent correlation. As a result, if the glide approaches infinity, then it will never come back down, disproves the Collatz Conjecture. See the following illustration showing how to achieve this effect.

Number	Glide
9	3
99	6
9999	11
99999999	21
9999999999999999	52
99999999999999999999999999999999	205

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Double it again, the glide is 378, then 595, 1670, etc. This was tested out to 999999, etc. (to 21,415 digits long), with the glide consistently increasing at a similar rate.

The trend is that for each time I double the number of 9's (in digits), the glide will roughly double. For graphing, using a linear graph, starting at 0. Add 3 glide for each extra digit of 9 added, giving us a slope of 3x with a Y intercept of 0, roughly.

Conclusion: Even while testing a number that was 2.5M digits of 9's long, with the help of my friend Lily, the calculation glide went hundreds of thousands of digits higher than it started before eventually getting back to the 4 2 1 loop. Every number that was tried followed the pattern of going down to the 4 2 1 loop eventually, but some numbers took a much longer time than what was expected. Some numbers went many times higher than the formula, and some others didn't follow the same wave pattern that most other numbers came out with to reach 1.

For example, most 9's peaked once and then came back down. A few peaked very high twice before going back down, and a few peaked many times higher than what the formula says they should have.

Therefore, by increasing the consecutive 9-digit length toward infinity, you will get a larger glide that will also reach infinity, giving you a number that never goes back down to the 4 2 1 loop. An infinite number of 9's will disprove the Collatz conjecture because it will have an infinite glide. Therefore, the conjecture that all numbers will go back to the 4 2 1 loop is false. The concept of infinite 9's disproves the theory.