Autobiographical Numbers

Cassidy Reitman, 2019

Introduction

Autobiographical numbers share an interesting property. These numbers are also known as self-descriptive numbers because individual digit values display how many of the subscript integer appears in the whole number. First, setting up a table will help when trying to find these numbers. Draw something around this:

$$\overline{0} \ \ \overline{1} \ \ \overline{2} \ \ \overline{3}$$

When placing digits into the numerator positions, remember that the number you placed, is equal to the value of the denominator position occurs. For example, a 4 digit autobiographical number is 1210 because there is one 0, two 1's, one 2, and zero 3's.

Problem Statement

Four digits is pretty easy, so my challenge was to find all the possible autobiographical numbers in our decimal system. This can get pretty difficult because the more digits, the more possibilities. I found a pattern which made my challenge much easier.

Results

First, I started off find the small autobiographical numbers. The two four digit autobiographical numbers, 1210, and 2020, are no trouble to find, with some trial and error. For 5, and 7 digits, my logic was to place a larger digit in the front, to represent the

trailing zeros, and solve the rest with trial and error. The autobiographical numbers that I found were: 1210, 2020, 21200, 3211000, 42101000, 521001000, 6210001000.

When attempting to find large autobiographical numbers, I noticed a pattern. The autobiographical number "521001000" is very similar to the autobiographical number "6210001000." But why? In these higher digits, I noticed there are many trailing zeros, which makes sense, because if there is, for example, one 8, then there would have to be 8 of some other digit to show up in the number. In my opinion, the lower digit numbers, (5, 6, 7) were more difficult than the higher digit numbers, (8, 9, 10.) Another thing that I found very interesting is that a 6 digit autobiographical number doesn't exist. It is impossible because any amount of trailing zeros doesn't line up.

Conclusion

I completed my problem with not much trouble. I found all possible autobiographical numbers, and found a pattern to help me with it. In order to make my problem slightly more difficult, I would try to find all autobiographical numbers in hexadecimal, a different number system. Hexadecimal numbers have 16 digits, in 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, instead of our ten, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. In this case, I would have more opportunities for more digits because I can have values like 15, compacted into one digit. Autobiographical numbers are unique, interesting, and fun!