**Team Number: LAHS-3**

**School Name: Los Alamos High School**

**Area of Science: Mathematics**

**Project Title: Efficient Retrieval of Irrational Numbers**

**Problem:**

Disregarding a spigot theorem for pi, it is very difficult to accurately and efficiently retrieve a given sequence from an irrational number. Given modern computing ability, this is made significantly easier by the fact that you can simply use a database to compare to and find that number you are looking for. The other problem encountered is that one has to go through all previous digits of that constant to get to the one you were looking for. Additionally, to do this for multiple different mathematical constants compressed into one function for increased efficiency is very difficult. This project is about finding ways to accurately do this for any given number of irrational or transcendental numbers in any given order.

**Solution:**

The solution involves graphing modular functions on a coordinate plane where the x-axis is all possible natural numbers in order from 0 to infinity. The y-axis is the function of mod z + w where z is the number of mathematical constant encoded and w is the interval distance from 0 the desired number when all of the original terms are put in order. One could use as many irrational numbers in this program as they want, and in any logical order they want. The program essentially finds all of the x-intercepts of the given modular function, where the x-axis has been superimposed by a number line of the digits of the desired numbers at a repeating interval. As an example, if you wanted to encode pi as the first of 4 mathematical constants, then the equation would be mod 4 + 0. The first modified plane would have the function of mod4 on the y-axis and n going to infinity on the x-axis. Then the x-axis gets superimposed by repeating intervals of the requested irrational numbers, in the requested order. The first x intercept would be 3, when the decimal place has been reassigned.

**Progress:** All of the mathematical concepts described above can be translated into either C++ or Python. One interesting artifact of the mathematics is that all digits of the constants are encoded, after a decimal place. And so for example with pi, the decimal would simply be .31415 and so on. Given this, the program has to compensate slightly and know to put the decimal one after the first digit; the 4 mathematical constants to first be encoded follow that pattern, though for other irrational numbers that would have to be adjusted. The 3 would be superimposing the 0 on the original x-axis.

**Expected results:** In general I expect to be able to do a couple ten thousand decimal places of 4 mathematical constants. The first program will run only 4 mathematical constants, though in principle you can encode as many irrational numbers you want. As long as the computer can handle the computation of the numbers, the mathematics of finding the x-intercepts on the modified coordinate plane should still stand for as many requested decimal places as you want.

**Team member(s):**

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