Number.Games

Evan Daniel
@ **evandaniel.com**

2022

Abstract

Number.games is a site housing games related to numerical cognition.
Link: **https://number.games**

I've created more games about numbers than I can count. Including permutations and quick experiments — not necessarily meant for distribution — I've programmed at least 250 games that address how we think about numbers between 2013 and 2023.

Although many of these games originate as attempts to help myself memorize π, they have the broader goal of researching our understanding of numbers. This connection is surprisingly direct. What does it mean to think numerically? Numbers can be encoded in almost anything; we think about everything from music to driving in terms of numbers (distinct from mathematical cognition). While we might count unconsciously at any moment — as per Leibniz's famous music is a hidden arithmetic exercise of the soul — to explicitly think in numbers we must translate this into a language.

This is also a more instructive activity than it might seem at first. Thinking about the symbol for the number 5 by itself doesn't necessarily mean thinking numerically; that would require a change representing the number five in some spatial, temporal, or symbolic medium. This is an active area of research for neuroscientists, who have found underlying principles such as the famous SNARC Effect, which finds that we have innate associations between quantity and spatial location.

One spatial arrangement that resonates strongly with numerical reasoning is the circle. Our number system has a base to it: after 9, we start back at 0 (and add a digit), and below 10 we start at the end again (9). Circles represent this mechanism perfectly. In the game Modular π, users can recite numbers in bases from 2-10. Having spent time playing this game, it's undeniable that each base represents a different kind of cognition.

I leveraged the same principle in a more complex version in which users recite π in ten bases all at once. Since there are ten bases, the order in which the digits are recited is determined by π in base ten; for example, 314 would be recited by reciting the next digit of π in base 3, then base 1 (just the single number 1), then the next digit in base 4.

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Figure 1: Logo, featuring 3, ., 1, and 4 playing a game.

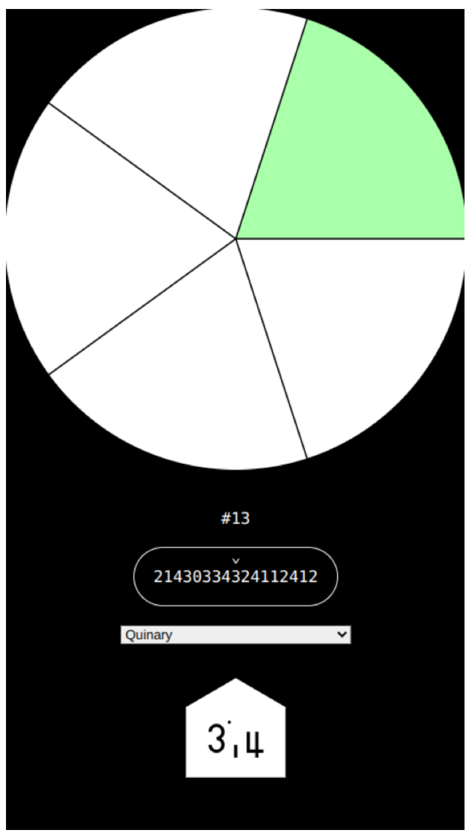

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Figure 2: This game on number.games uses a circular UI to represent differences in numeric bases.

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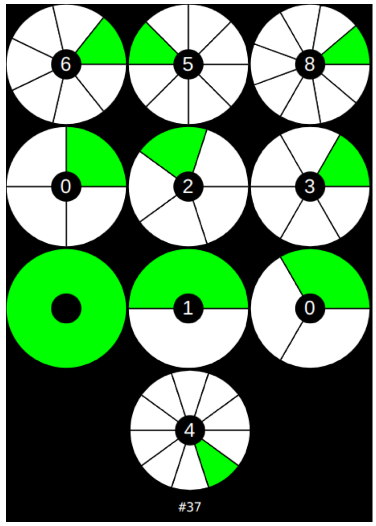

Figure 3: This game on number.games requires the player to switch between different bases to recite π in base ten.

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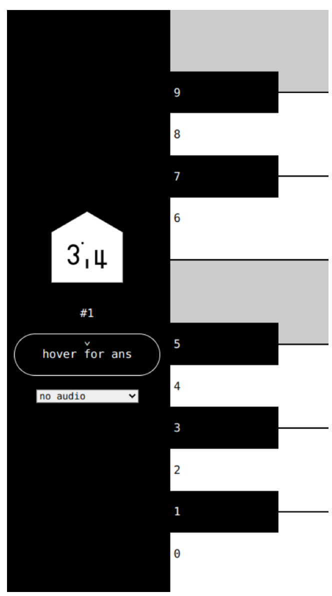

Figure 4: This game on number.games requires the player to use indexing to perform mental arithmetic on a Soroban abacus.

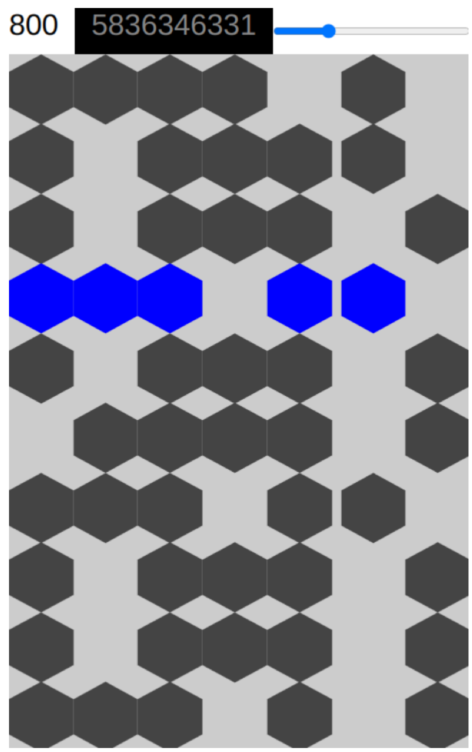

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Figure 5: This game on number.games requires the player to use indexing to perform mental arithmetic on a Soroban abacus.

But the ability to think in numbers is not limited to spatial arrangements; we can also think about numbers arithmetically. In the above game, users recite π multiplicatively; that is, to recite 314, they move three columns to the right, multiply 3 by the column index, and then add it to the numbers that are already there. While the numbers could be represented in any way, I've chosen the convention of the Japanese Soroban abacus, with movable beads. This sort of arithmetical method is very close to the process of multiplying large number. This might be why the process — while complex — is surprisingly natural.

Another motif of number.games is that learning numbers can be concurrent with learning an independent system. Numbers are related to the keys of the piano only on a purely symbolic level; you can call any key on the piano any number that you'd like. But the arrangement of keys on the piano also encode the assumptions of western music; the repetition of twelve keys implies that there will be twelve tones in an octave. So in a sense, this game could just as easily be considered a game about learning the piano, in which the content of the game is the randomness of the number π.

This is quite close to Serialist and Twelve-Tone traditions in contemporary concert music. Those traditions sought ways to transcend musical conventions by using external series to expose the mechanics of the underlying audio systems being used. With that in mind, I developed a simple audio synthesizer for the app. While the format of the piano prefer twelve tones, users can also use alternate tunings, including base ten or a non-logarithmic scale.

On a more abstract level, number.games resonates with the ideas of Post-Structuralism. Post-structuralism implies that the encoding that we use in a language changes the way that we think. However, language here is extensible beyond natural language, and Post-Structuralism applies equally to non-verbal languages such as painting, media, or music.