# It's Fibonacci's Bit - Seeding the Universe with 0 and 1

**Antony Ryan**

17 May 2013

**Abstract.** John Wheeler suggested that information is fundamental to physics, resulting in the very nature of what we observe. However, any information that passes beyond an event horizon becomes empirically lost. What happens to it? Here, I explore the fundamentals of *how* information is exchanged in reality, how it changes, and any potential for it to be destroyed. Remarkably the Fibonacci sequence, appearing so often in nature, is revealed from this voyage, bringing with it possible answers to Wheeler's question.

## Wheeler's 0's and 1's

John Wheeler suggested that everything we observe in the known Universe (the it) is less fundamental than the information that produces it (the bit); bit short for Binary Digit, in turn owing to the Binary code used to store information in computing. I ask could the Universe have a base 2 system with 0 and 1 at its foundation.

Wheeler was also known for popularising the term 'Black Hole', which is a great place for Quantum Gravity to emerge and information to hide. I suggest in this essay that the foundations for reality begin with emergence of 0 and 1 dimensionality at a singularity resulting in the Universe we live in and in which information is processed.

## Fibonacci's 0 and 1's

By definition, the first two numbers in the Fibonacci sequence are 0 and 1, and each subsequent number is the sum of the previous two.
The sequence $F_n$ of Fibonacci numbers is defined by the recurrence relation:

$$F_n = F_{n-1} + F_{n-2}$$

with seed values

$$F_0 = 0, F_1 = 1$$

Both the Fibonacci sequence and Wheeler's foundational question rely upon 0 and 1. Despite Wheeler's 0 and 1 being mainly symbolic, the basic idea of 0 and something as alternative answers to yes/no questions lends to information. Likewise, Fibonacci begins with something and nothing.

Fibonacci numbers occur in mathematics as the sums of shallow diagonals in Pascal's triangle, they can be found in different ways in the sequence of binary strings, and are related to the Golden ratio. Every second Fibonacci number is the largest number in a Pythagorean triple. All positive integers can be written as a sum of Fibonacci numbers. Fibonacci sequences appear in biological settings, in two consecutive Fibonacci numbers, such as branching in trees [1], arrangement of leaves on a stem, the fruitlets of a pineapple [2], the flowering of artichoke, an uncurling fern and the arrangement of a pine cone [3]. The Fibonacci numbers are also found in the family tree of honeybees [4].

Perhaps it isn't too much of a leap of faith to include reality's relationship with information, "It from Bit", as another of Fibonacci's attributes.

The link between Fibonacci and Wheeler may seem speculative however I will show a logical relationship which the Fibonacci sequence has with both information and reality.

## A thought experiment: Descent into a Black Hole (and back out)

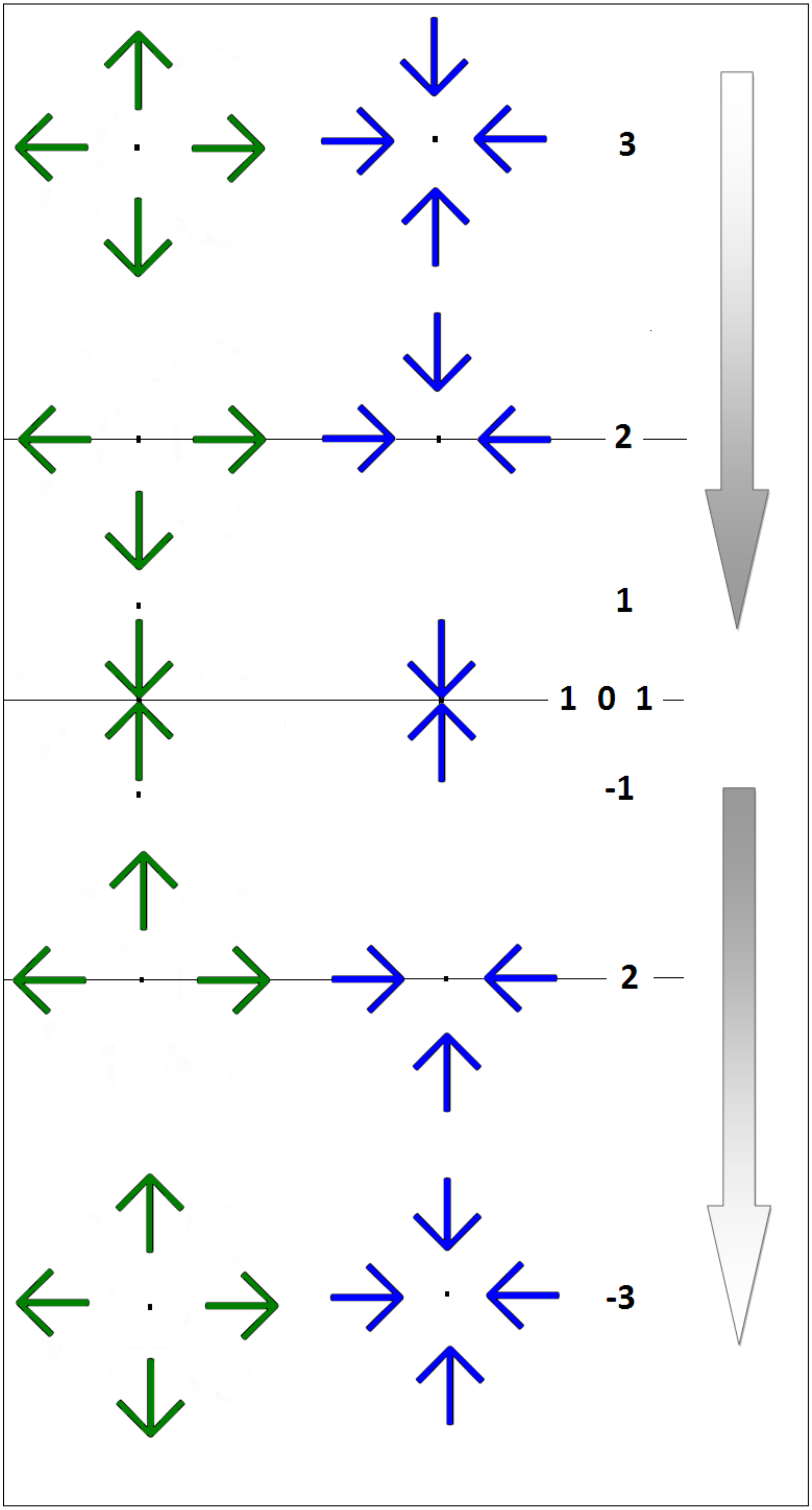
Interaction, observation and being observed, is key to all of physics, and information is at the heart of this. Normal 4-dimensional space-time comprises 3 spatial dimensions which allow the passage of information, as time passes, between separate points in space-time. That is, a particle, for instance, can observe, inwardly receiving information 3-dimensionally, while outwardly revealing information 3-dimensionally.

Using this train of thought, at a Black Hole's event horizon, information is not so free in all spatial directions – no pathways lead outwards. Information can be received 3-dimensionally from outside, but no information from inside the black hole can be received. Likewise at the event horizon information can be revealed 3-dimnesionally towards the singularity, but nothing can be revealed outwards away from the black hole, because no pathways point outwards. The only direction where information can be both received and revealed is 2-dimensionally across this 2-dimensional horizon.

Once inside the Black Hole, pathways tend towards greater and greater spaghettification, before the 0-dimensional space is reached at the singularity, at some critical point, information can only be revealed 1-dimensionally. Finally at the singularity itself, information can only be received from that point 1-dimensionally.

At the singularity information cannot be received nor revealed because there are, by definition, 0-dimensions of space at that unique point. Hence, we can envisage information having discrete and limited environments for its passage. 0 and 1 emerge as dimensionalities concerned with the singularity itself – quite binary, and, as we know, the seed values for Fibonacci.

Figure 1 shows that as we descend into a Black Hole, different "altitudes" present information with unique processing limitations, to the order, 3, 2, 1, 1, 0 dimensions respectively; this matches the Fibonacci sequence.



3
2
1
1 0 1
-1
2
-3

**Figure 1.** How information is exchanged following the Fibonacci sequence when moving into and "out" of a Black Hole.

We know that the Fibonacci sequence continues past 0:

**-3, 2, -1, 1, 0, 1, 1, 2, 3** [5]

At the singularity, knowing that no pathways move outwards from anywhere beyond the event horizon, we imagine what becomes of any attempt for information to escape. This is where Fibonacci really assists in explanation. The sequence itself allows -1 + 1 = 0, a simple quantum fluctuation akin to a vacuum. I would suggest that this is what naked singularities do.

In larger supermassive black holes with the presence of an event horizon, this takes the sequence nearly full circle to have 2, -1, 1, 0, 1, 1, 2, 3 dimensional arenas for information to exchange. They are all unique, for example the positive sequence 2 represents the event horizon when heading into the black hole, the negative sequence 2, is the result of building new event horizon – conserving dimensionality when the sequence follows through to this point. The final part -3-dimensions, again conserves dimensionality by giving the Universe outside the Black Hole information, confirming that a bit of 3-dimensional space has fallen in, so the Universe gets -3 back out.

## Entropy

The Universe seems to want information to fall into a Black Hole; entropy is perhaps the driving force for this.

A simplex is the smallest convex set containing n+ 1 vertex for n-dimensions, such as a 2-dimensional triangle containing 3 vertices. I posit utilising n+1 to explore entropy, as a representative of the respective dimensionality's order.

If we assign the n-dimensional n-simplex, then the number of vertices n+1 increases with "decay" from $VF_n \rightarrow VF_{n-1} + VF_{n-2}$ working backwards through Fibonacci's sequence. In other words, as information falls into a Black Hole, its entropy increases more than the decrease in entropy for the outside Universe.

Table 1 shows an increase in disorder moving from $VF_n \rightarrow VF_{n-1} + VF_{n-2}$ This is always an increase of 1 for the positive Fibonacci sequence. However once $F_n$ = -1 becomes part of the vertex result the simple relationship is lost.

To continue to achieve the +1 decay results, we must reach a strange conclusion that dimensions with negative Fibonacci numbers give a simplex vertex number of 0, i.e. the mean of the positive and negative vertex numbers. If we consider just the negative dimensions with negative vertex simplex numbers, we get a reduction in entropy, which we'd expect mathematically. This would result in a -1 change, or fall in entropy.

Assuming positive simplex numbers based on an axiom that dimensions can't be negative, then entropy increase would be large. However, if we take the mean of both these results, we increase entropy by +1 as before.

I would suggest that in real terms, considering negative dimensions to exist only as quantum fluctuations of a singularity (0-dimension), which would then naturally favour positive dimensionality asymmetrically, producing a natural arrow of time. However, all these outcomes, once 0-dimensionality is reached (and exceeded) give three strangely diverse quantum like results, such as:

i) The singularity does not release information at all, because continuing on Fibonacci's sequence results in an entropy decrease.

ii) The singularity can release the same amount of information that it receives, as entropy continues to increase as previously.

iii) The singularity is capable of releasing vast amounts of information. This would occur if the Black Hole was losing a lot of mass, which brings us to Hawking Radiation.

| Fibonacci Number $F_n$ | n-vertices of n-dimensional simplex $VF_n$ | Vertex sum $VF_{n-1} + VF_{n-2}$ |
|---|---|---|
| 5 | 6 | **7** |
| 3 | 4 | **5** |
| 2 | 3 | **4** |
| 1 | 2 | **3** |
| 1 | 2 | **3** |
| 0 | 1 | (0+4) $\bar{x}$ = **2** |
| 1 | 2 | (1+5) $\bar{x}$ = **3** |
| -1 | (-2 or +2) | (-1+7) $\bar{x}$ = **3** |
| 2 | 3 | (2+10) $\bar{x}$ = 6 |
| -3 | (-4 or +4) | |
| 5 | 6 | |

**Table 1.** "Decay" from $VF_n$ to $VF_{n-1} + VF_{n-2}$ produces an increase of 1 suggesting an arrow of time.

## Hawking Radiation

The presence of -1 dimensionality evokes the possibility of Hawking Radiation, where the Black Hole can lose mass and according to this approach, information. For the negative dimensionality, it is only when we consider both the positive and negative simplex vertex numbers that we achieve increase in entropy consistent with that of the positive part of the sequence. Decay from $F_n$ = 0 → +1 -1 would seemingly result in annihilation back to 0, but +1 also has the capability to decay to 0 +1.

Notice the repeating nature of the -1, 1, 0, 1, 1 part of the sequence, which allows Black Holes without the 2-dimensional event horizon (naked singularities) to very quickly lose mass. The other route involving 2-dimensionality retains the self-replicating +1. Larger Black Holes should lose less mass, as there is less chance to lose 1 and maintain -1 (Hawking Radiation) the more 2-dimensionality it has. However, when information escapes in this manner, it should mean that it is conserved, albeit unrecognisable from before it was massively altered inside the Black Hole.

$F_n$ = 2 dimensionality in the negative sequence decays to $F_n$ = -3 and 5, but the simplex vertex product $VF_n$ increases from 3 to 6 (an atypical increase of +3), not following the simple +1 pattern for the mean. The lower result is an entropy decrease of 1, while the upper result would increase entropy by $VF_n$ = 7, resulting in loss of mass from the Black Hole. Hence, it seems decay onward to 5-dimensions isn't favoured either symmetrically or asymmetrically, giving 3-dimensionality a limit in our reality and in information exchange.

## Conclusion

Fibonacci, It and Bit appear equally fundamental, as the sequence gives information to reality on how information can be exchanged - a sort of “chicken and egg” relationship.

Dimensionality number is conserved during “decay”, adhering to the reversal of the Fibonacci sequence, while showing an increase in entropy via n-simplex vertex number. This means that information is also conserved, but left much less ordered, when entering a Black Hole. At 0-dimensions information can’t be processed. But the sequence 1 → 0, 1 reproduces 1, so that information is never destroyed.

Utilising this approach to understand information’s relationship with reality has shown potential to help in our further understanding of the asymmetry of time.

Any information remaining inside the Black hole is not destroyed and the original dimensionality is always conserved by following the Fibonacci sequence; it may just be in some instances that it may take an infinite amount of time for information to escape.

This system also lends itself to a spatially 3-dimensional Universe emerging from 0-dimensionailty, because information exchange is limited to 0, 1, 1, and 2-dimensionailty within a Black Hole, which is hidden from the 3-dimensionality outside. In this respect Black Holes are analogies to the holographic principle in reverse.

## References


[1] Douady, S; Couder, Y (1996), "Phyllotaxis as a Dynamical Self Organizing Process" (PDF), Journal of Theoretical Biology 178 (178): 255–74,doi:10.1006/jtbi.1996.0026

[2] Jones, Judy; Wilson, William (2006), "Science", An Incomplete Education, Ballantine Books, p. 544, ISBN 978-0-7394-7582-9

[3] Brousseau, A (1969), "Fibonacci Statistics in Conifers", Fibonacci Quarterly (7): 525–32

[4] The Fibonacci Numbers and the Ancestry of Bees

[5] Knuth, Donald (2008-12-11), "Negafibonacci Numbers and the Hyperbolic Plane"