A constructor algorithm of reality

Tariq Khan
Omaha, NE USA

A proposal for a short constructor algorithm that, after an initial bootstrap instantiation, might describe consciousness and many aspects of human reality.

> *"Time is but memory in the making"*
> *-- Vladimir Nabokov*

> *"Explain time? Not without explaining existence. Explain existence? Not without explaining time."*
> *-- John Wheeler*

> *"The concept of the computing universe is still just a hypothesis; nothing has been proved. However, I am confident that this idea can help unveil the secrets of nature."*
> *-- Konrad Zuse, Rechnender Raum (Calculating Space)*

> *"If I am going to have an account that fully explains what's going on when a scientist measures a system in quantum physics and deals with entanglement and all these other things, what if it turns out that that account must appeal to consciousness? Does consciousness then become part of physics? If it does, then — in a way — the debate between physicalists and dualists dissipates because the physical has just absorbed consciousness. But the dualists would have won in the sense that consciousness doesn't reduce to any of these other things. That is what they've been claiming for a few centuries..."*
> *-- Angus Menuge*

> *"Being an irrational number, π cannot be expressed exactly as a fraction (equivalently, its decimal representation never ends and never settles into a permanent repeating pattern). Still, fractions such as 22/7 and other rational numbers are commonly used to approximate π. The digits appear to be randomly distributed; however, to date, no proof of this has been discovered."*

> *"So how can a brain perform difficult tasks in one hundred steps that the largest parallel computer imaginable can't solve in a million or a billion steps? The answer is that the brain doesn't "compute" the answers to problems; it retrieves the answers from memory. ...The entire cortex is a memory system. It isn't a computer at all."*
> *-- Jeff Hawkins, On Intelligence*

> *"This is exactly what Bekenstein and Hawking discovered about spacetime. It is redundant. Two dimensions contain all the information in any 3D space."*
> *-- Donald D. Hoffman, The Case Against Reality: How Evolution Hid the Truth from Our Eyes*

> *"It is a great ball resting on the flat back of the world turtle." "Ah yes, but what does the world turtle stand on?" "On the back of a still larger turtle." "Yes, but what does he stand on?" "A very perceptive question. But it's no use, mister; it's turtles all the way down."*
> *-- Carl Sagan, Gott and the Turtles*

Many a great mind has sought a Grand Unified Theory to explain our reality. Similar minds have also suspected that our Universe or reality had origins from a simple start e.g., a Big Bang or cellular automata rule set (Figure 1 and Figure 2). So perhaps there is a simple equation or algorithm that can explain features that we find in our reality. This work presents a model using very simple pseudo-code, and an initial intelligence (required to bootstrap initiate the repeating code), as another template in this same theoretical direction.

Now academic and scientific culture derides any mention of a primordial consciousness, mind, or God-like intelligence but, although tremendous progress has been made in terms of unifying forces in our

Universe, the goal of a simple and primordial equation or theory has remained elusive, as has an explanation for human consciousness.

This model imagines an initial intelligence that may inherently exist a priori or before the very creation of our Universe - akin to a mind in a Platonic dualist world. This intelligence could be ever-present but is required only minimally to bootstrap our algorithm "out of nothing" to begin the process, akin to the starting point of Set Theory. Echoing writings of Descartes, we can imagine a primordial awareness or intelligence that can identify and distinguish itself from that-which-is-not-itself. This "primordial cut" is considered an instantiation act and would minimally require - simultaneously or beforehand - at least two "units of memory" - that may or may not be internal to our reality. From this starting point our simple algorithm can be used to explain a vast set of features present in our reality after this origin act.

Consider a simple constructor algorithm. The term *constructor* borrowed from the JAVA "object oriented" programming language subroutine and from the name of theoretical work by Oxford quantum physicist David Deutsch. In the Biblical book of Genesis 1:3 we have the famous existential line of "Let there be light." But note here that various elements are involved in this statement. There is the mind of a God, that makes a decision to "cut" reality into two segments, one with light and one without light (darkness). We face an obvious challenge to attempt to describe origins from a realm that might be timeless or without any entities or consciousness or perhaps filled with both. But if we assume that logic holds, even during our bootstrap start, then perhaps, following the beliefs of so many cultures in history and around the world, we must start with an initial awareness or intelligence. Consider the existence of a primordial mind with memory, awareness of a self, and a primordial "cut" decision, or segmenting of self from non-self, with these two concepts inherently stored in a primordial memory of two units. Perhaps these are the very first units of a fundamental "unit" of spacetime in our Universe. One can imagine this since, as our algorithm continues to repeat, it basically resembles a Fibonacci Sequence and, thus, increases at a rate that approaches an exponential growth rate (Figure 3). But as our reality becomes vast, we can see the growth rate of memory units increasing even more. This is of interest as it mirrors observations in our Universe that show our Universe growing at similar incredible rates attributed to Dark Energy.

To summarize, our proposed algorithm starts with a primordial awareness and with the start of time (change), cuts into self and non-self (vis a vis binary 0 and 1 or "something and nothing") and then the algorithm repeats with our entire Universe of spacetime being inclusive to this primordial realm of non-self. Two units of memory are added (some steps like registers are ignored in our pseudo-code for ease of discussion) and a one-dimensional point in the "non-self" portion of reality is "cut" creating point 1 and point 2, point 1 and 2 define Line1, and Line 1 is cut to create Line 1 and Line 2. Line 1 and Line 2 are used to define a two-dimensional circle and non-circle entities. This add memory, cut, and repeat process continues ad infinitum. Here we need to clarify the use of the word *cut*. The term perhaps is closer to the idea of a schism. The cut can be a mental or logical identification or segmentation e.g., one line into two lines or even the breakdown of molecule into its component elements then protons, neutrons, and quarks, electrons, photons etc. But the algorithm remains the same in a much later complex Universe as simple decisions (go left or go right?) or even entropy itself where particles decays into foundational particles and quarks as if attempting to return to foundational origins of structure versus randomness. The primordial cut being synonymous with "something from nothing" or structure versus randomness akin to the Chinese origin philosophy of Yin and Yang. After our two-dimensional reality is instantiated, the cut function thus leads to an aggregation function i.e., NOT-CUT or combine. This is the basis for memory and ideation hierarchy e.g., lines become letters, words, sentences, paragraphs, pages, chapters, books, and libraries. All subsequent opposing "strategies" thus mirror CUT vs NOT-CUT including hatred vs desire, attachment vs aversion, decay vs survive. A reality after that primordial instantiating "cut" now exists where, even if only in two physical dimensions along with time, we can repeat the same algorithm to produce a third dimension (if even needed) and a reality of immense complexity. University of California Irvine cognitive psychologist Donald Hoffman argues that the third dimension does not exist and is used only as informational redundancy to improve fidelity of two-dimensional data. This theory is also possible in the framework of this model. This model does not necessarily require a third dimension to achieve its success in creating so much of what we observe in our reality.

Note the appeal to an origin constructor algorithm is that it may be able to eliminate inherently dualist cosmological models that involve Laws of Physics that exist a priori or before the creation of our reality in a Platonic Universe of perfect circles, infinity, and ideas. Perhaps the ongoing challenges with unifying Gravity with the other fundamental forces or the Standard Model are because Gravity is a result of

foundational cutting algorithm events (minimization of surface areas) versus the existence of graviton force-carrying particles like other fundamental forces in Nature.

Note too how Quantum Mechanics, at a fundamental level, shows that our Universe is "cut" into identical minimal entities (photons, electrons, quarks, etc.…) and that when one attempts to determine an attribute of one of these entities with an increasing level of detail, the detail of the corresponding attribute is decreased (position vs momentum as the classic example of the Heisenberg Uncertainty principle). This behavior echoes a reality that "prefers" cuts and segments i.e., one or the other but not both! Note too the lack of an observed decay of a proton or quark or electron. Our simple constructor algorithm: 1) bootstrap initial intelligence, 2) add two units of memory, 3) cut, and 4) repeat (Figure 4), produces results that we see in our reality and becomes almost synonymous to entropy i.e., driving (cutting) entities toward disorder.

The Principle of Least Action, so fundamental to our reality, becomes a logical outcome of this constructor algorithm. The appearance of π, present in so many realms of our Universe, becomes a necessary result of our model as does the existence of so many shapes that resemble circles or spheres (Figure 5).

With the assumption of an initial or foundational intelligence, perhaps Nature, that attempts to use all tools at her disposal, has simply appropriated the boot code of the Universe and, with the complexity of evolved biological brains, is then able to reuse that code, thus leading to consciousness? Nature wants fecundity and variety, and it wants these ultimately to ensure survival. Nature, thus, uses all tools at its disposal; consider how plant life uses aspects of Quantum Mechanics to optimize photosynthesis i.e., Quantum Biology. Thus, it is not a stretch to consider Nature appropriating boot code from an underlying reality. This could explain the existence of consciousness in human minds as Nature using the "bootstrap code" of the Universe for its own benefits to help ensure survival.

Note how in this model numbers exist or originate as "labels of minimum memory size." So now let us consider the origin of π. Upon the creation of a circle following the cut of Line 1 into "Line 1 and Line 2," we have an actual boundary between Circle and Non-Circle; the circumference of the circle (Figure 6). If we attempt to measure or calculate the length of the circumference of this unit circle (diameter of length 1) we begin to require a vast amount of memory units. Here, many assumptions are made but they lead to some interesting conclusions. In our model the length or digits of π do not exist a priori or in a Platonic realm of infinity but, rather, must be calculated. But π is a very special number, and a special irrational number, indeed. Since π lies on the border between circle and non-circle it, literally, is the maximum amount of randomness and the minimum amount of structure possible. But in our model, to ensure a string has non-repeating and perfectly random digit placements, implies a need to not only have a memory unit for a given digit (a la an instantiation cut) but also a memory unit(s) for all of the possible permutations of every digit and digit string up to and then including the digit in question as well as the implied memory to compare them to ensure no pattern or eternal repetition exists. This idea is speculative, and resides in the field of metaphysics, but it still is simpler than a required Platonic Universe with a priori infinitely long numbers. In this model, the memory is added as digits in π are measured. Does this mean that measuring the digits in pi could be increasing the size of the Universe – perhaps?

Now let us compose an updated "short history" of man's attempts to understand reality:

- Plato - reality must be dualist - a world of ideas and a physical world of material (cave shadows).

- Democritus – reductionist approach; Universe built from identical fundamental tiny atoms.

- Rene Descartes - I and not-I is start.

- Isaac Newton - mathematical rules underly reality; predictive time functions (calculus) and "law" of gravitation pattern; spacetime as absolute.

- Gottfried Leibniz - reality from 0 and 1 - starts at two dimensions with the rest functions of time and change (calculus); relational foundation of reality.

- Charles Darwin - Nature appears formulaic, evolution via fitness = recursive optimization algorithm.

- Albert Einstein - reality is a function, with space and time as a single operation! Gravity is derivative of this. Speed of light has max velocity but zero memory. No relative velocity = max memory = slowest clock time. General Relativity directly implies expanding universe and origin from single start Big Bang vs Cosmology.

- Kurt Gödel – there can never exist a finite complete system without a higher order awareness!

- John Von Neumann - set theory is only way to create math - requires a bootstrap into null set. Designs computer architecture based on memory!

- Alan Turing - code for an operating system and for program or data are both able to be encoded into the same string of code! All we need is a single "Universal Turing Machine" to "read" (cut into memory) infinite tape of binary symbols.

- Richard Feynman and John Wheeler – pursued the "why of quanta" (identical, long lasting, fundamental particles). IT from BIT. Reality is derivative and consistent with rules fundamental - delayed choice quantum eraser. "Sum of all histories" implies memory (if not awareness) with fundamental "which path" choices. Quantum mechanics is younger sister of computation

- Jacob Bekenstein - Holographic paradigm from black hole thermodynamics - all info of reality coded into 2 dimensions!

- Stephen Wolfram and Konrad Zuse - reality is a "cellular automata" at foundation starting with a simple rule deeper than physics Grand Unification theories.

- Donald Hoffman - there is no 3rd dimension at all! Our reality is all 2 dimensional. All of reality is a fitness algorithm.

- David Deutsch - computation is THE foundation of reality. A "constructor" must exist like in Java code. Multiverse advocate. Multiverse = dual reality (mind or "realm of infinite" is separate from brain)

- Lee Smolin - all realities (Universes) evolve from prior ones in eternal evolution toward complexity and fecundity (via more Black Holes after every big bang).

- Various biologists - Nature appears to be algorithmic and a "distributed intelligence" using any tool it can (over billions of years) to ensure survival via variety, fecundity, complexity e.g., photosynthesis using path optimization aspects of Quantum Mechanics and slime model problem-solving.

Thus, in attempt to tie together all of these concepts, perhaps all of reality is an algorithm that requires at least an initial bootstrap of intelligence (a la a "toe dip" into a dual world). Reality is two-dimensional with time and THE simple function of "add at least two units of memory, cut or aggregate (inverse cut), and repeat." In a manner, man is therefore actually "created in the image of God" as Nature appropriates reality's bootstrap code that, used with a complex enough brain becomes what we call and experience as consciousness.
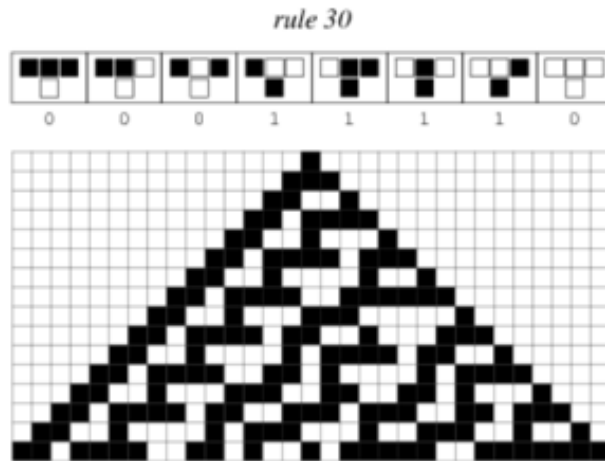
Figure 1.

An initial dream of an origin to reality via binary mathematics: "2, 3, 4, 5, etc. 0. Omnibus ex nihilo ducendis sufficit unum." (To make all things from nothing, unity suffices) from Gottfried Wilhelm Leibniz's imago creationis

LEIBNIZ'S IMAGO CREATIONIS.

Source: Mutalik, P. (November 24, 2021). Why e, the Transcendental Math Constant, Is Just the Best. Quanta Magazine. Retrieved from: https://www.quantamagazine.org/why-eulers-number-is-just-the-best-20211124 December 20, 2021.

Figure 2.

Cellular automata examples start with simple "a priori rules" (cuts or decisions) and then grow into complex patterns and structures; primordial rules determine the future evolution of structure.

Source: Rule 30 Cellular Automata image retrieved from Wolfram Mathworld. Retrieved from: https://mathworld.wolfram.com/CellularAutomaton.html on December 20, 2021.

Figure 3.

After the bootstrap instantiation, repeating the constructor algorithm shows how the count of required memory units matches the ever-present Fibonacci Sequence we see in our reality.

			2	3	5	8		
MEMORY UNITS (sum)			2	3	5	8		
FIBONNACI SEQUENCE	0	1	1	2	3	5	8
		self	self	self			
		non-self	non-self	non-self			
			self+non-self (all)	self+non-self (all)			
				non-self, point			
				non-self, not-point			
				non-self, point+not-point = non-self			
				self+non-self, point, not-point = all			

Figure 4.

Visual representation of the constructor algorithm. Where, or in what "mind," lies the primordial memory units is the dualist assumption required in this proposal to bootstrap instantiate reality.
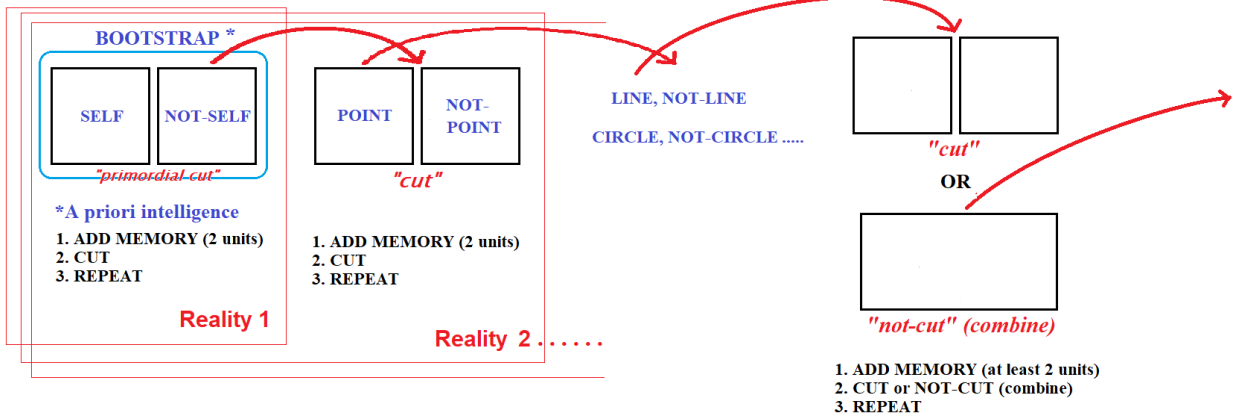

BOOTSTRAP *

| SELF | NOT-SELF |

"primordial cut"

***A priori intelligence**
1. ADD MEMORY (2 units)
2. CUT
3. REPEAT

Reality 1

| POINT | NOT-POINT |

"cut"

1. ADD MEMORY (2 units)
2. CUT
3. REPEAT

Reality 2 . . . . . .

LINE, NOT-LINE

CIRCLE, NOT-CIRCLE .....

"cut"

OR

"not-cut" (combine)

1. ADD MEMORY (at least 2 units)
2. CUT or NOT-CUT (combine)
3. REPEAT

Figure 5.

Is the "reality" outside of our window – that is full of demonstrations of gravity, of the principle of least action, and of Fibonacci Sequences – just a vast repetition of "memory adds" and concept "cuts" scaling to the entire Universe?
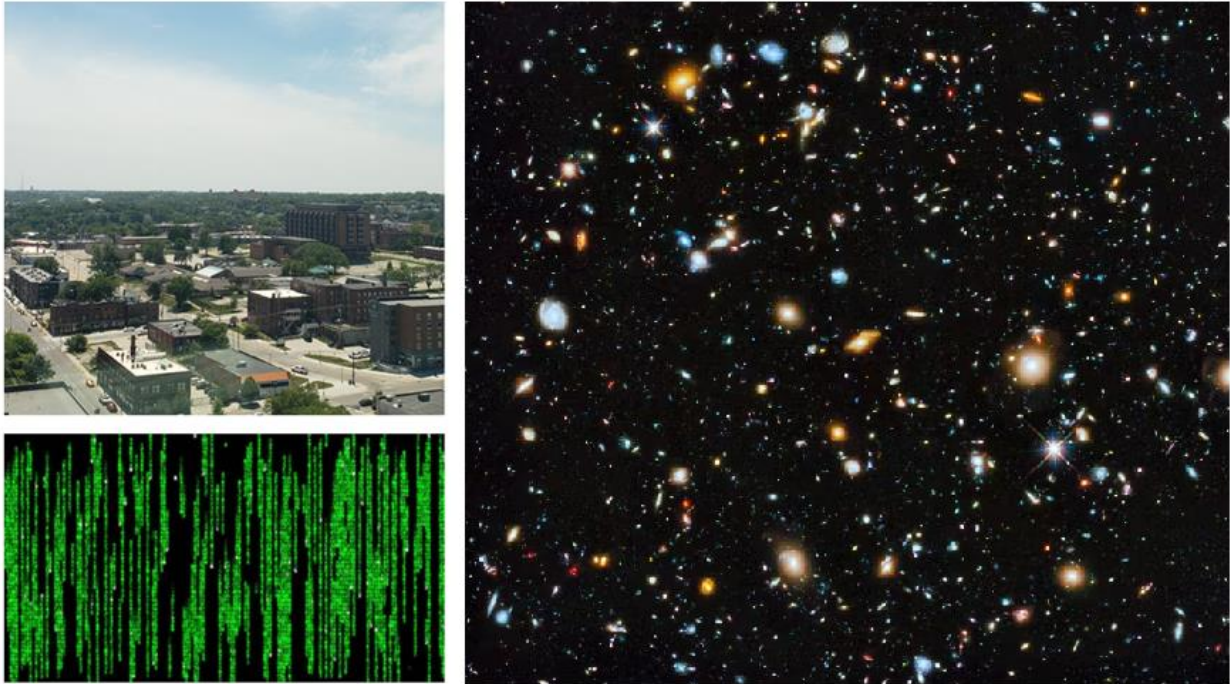
Figure 6.

*The minimal area of a two-dimensional "reality" encompassed using previously "cut" entities **line 1** and **line 2,** is a circle; they remain independent and not crossing. The boundary of randomness vs structure (e.g., maximum randomness = minimal structure) is the circumference of the circle. The length of the circumference is, thus, measured as diameter (line 1) x π. The circumference, thus, defines the length required of **line 2** in order to create a boundary between our new concepts of **circle** (yellow region) and **non-circle** (blue region). Π, thus, is a simultaneous minimum and maximum "cut" border and, thus, is ever-present in our reality.*