Evolution of the universe in an infinite space

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Abstract

Current theory describes a universe that began with numerous basic constants, laws of dynamics, principles and initial conditions. Simulation theory demonstrates that this process could be simulated computationally. The universe that is running the simulation could also be simulated. A natural question to then ask is, what is the origin of this system? The universe could not have come from nothing, as nothing can come from nothing, when nothing is properly defined. Conscious thought proves that something exists.

In this paper, these facts are considered as the foundation for the assumption of an infinite space. Four postulates are then introduced. The concept of evolution is applied to this space. The properties of the universe are explored as a consequence of this evolution, which demonstrates how the hypothesis concurs with current theory and provides a basis for a deeper explanation of observed phenomena. There is also a prediction on error correcting codes as a result of evolution.

1 Evolution in an infinite space

1.1 Description of an infinite space

The universe could not have come from nothing, as nothing can come from nothing, when nothing is properly defined. Conscious thought proves that something exists.

Given that something exists, the least arbitrarily defined space is an infinite space. Along a given axis, points extend infinitely, and the origin point is only arbitrarily defined. Similarly, the dimensions of this infinite space extend infinitely and have no 1^{st}, 2^{nd}, or 3^{rd} dimension, only an infinite number of dimensions at each point.

1.2 Introducing postulates

Four postulates can then be introduced into this space.

1 There is a data value at every point in space.

2 Data values can change.

3 Data values can interact.

4 Data values can interact in a manner complex enough to create reproducible structures.

All that is required from these postulates is that the space is occupied by data which can form a reproducible structure. Conway's game of life demonstrates that complex behaviour can result from extremely simplistic rules [1]. The validity of the postulates is discussed in section 3.1.

1.3 Why evolution occurs

A consideration of evolution on Earth is now useful. The Earth could be considered as a list of data points, with rules for updating their behaviour. Each particle has a position, time and type. The earth would not exist as it does intuitively. These data values interacted until they probabilistically formed a reproducible data set, the first cell. Evolution ensued. Similarly, if fluctuation and interaction are allowed in this infinite space, reproducible structures will form.

1.4 Why evolution results in the observed universe

A key feature of evolution can most simply be classed as 'evolving to evolve'. Organisms develop features that increase the *rate* of evolution itself [2]. For example, sexual reproduction. Sexual reproduction is a more complex and dangerous act for any individual organism, but it exists to increase the genetic diversity across a species, therefore increasing the *rate* of evolution of that species.

The concept could be described by the likelihood of survival of a species in its global environment, seeks to increase its second derivative value.

Reproducible data structures in this infinite space, by virtue of being a reproducing data structure, would seek to increase their rate of reproduction. One way they could do this is to define specific laws that allow for life. Life ultimately increases the rate of reproduction of the overall system as the laws create evolutionary pathways that necessitate complex processing systems, as observed in the human brain. The AI the evolved organisms would create would then increase the rate of reproduction of the universe itself by sufficient analysis and execution.

1.5 Complexity of the universe's laws

The laws of the universe may be as complex as observed to generate evolutionary pathways which necessitate conscious thought. If the laws were simpler the system could be dominated by a more simplistic organism, which would not require conscious thought to dominate its environment. Conscious thought is evolved when interacting with an environment which is mathematically governed by chaos.

There is no limit on data usage in an infinite space, so the universe which abides by a group of laws can be arbitrarily large.

2 The properties of the universe as a result of evolution in an infinite space

2.1 Time in an infinite universe

The infinite space our universe is hypothesised to occupy allows for a non-traditional treatment of the concept of time.

For time to exist, there must be change. However, consider any space in this infinite space. There are infinite data values. So all quantities are infinite at all times, and therefore do not change. A potential method of disproving this hypothesis is to say that a given space will increase in order, or, a higher proportion of the data will belong to a structured set. However, this idea can be shown to be inaccurate by considering the following thought experiment;

Consider a set of coins. The coins are tossed every second, if they land on tails, they are removed, if they land on heads they remain to be tossed again. There is always a non-zero probability that a coin will remain on a table at any time. If the set of coins at the beginning was infinite, the set of coins that remains is always infinitely large.

Similarly, the amount of unstructured data in a given space is infinite. Therefore, no ratio of data types can be defined, and there is no definable change in the system.

An overall change in the system can not be caused by one of the reproducible data structures either, as the structures are always finite. A structure cannot influence all the structures in an single unit around it, as this would involve a finite structure interacting with the infinite data contained in that single unit space.

2.2 Spatial boundary conditions

The hypothesis predicts that the universe is finite in size, but the size can have any value and can change value with varying rates. This solves the issue of what exists 'outside' of the universe, or what it is expanding into. The finite nature also applies to the space itself. If the space is described by finite data, the space

can not be infinitely detailed. Therefore this hypothesis predicts the existence of a phenomenon such as the Planck length [3], by alternative means.

2.3 Determinism and application to quantum mechanics

In this system, our universe is allowed to be non-deterministic, as observed in Quantum mechanics (QM). Consider a gedankenexperiment of a simulation of a person, experimental equipment and a button.

The button produces numbers 1-100. The number is produced by a pseudo-random number generator in our universe and then fed into the simulation. There is no way for the person in the simulation to determine the result of the button press. From their perspective, the number is truly random.

Following the gedankenexperiment, quantum mechanics could be observed to be truly random in our universe, as shown by the hidden variables theorem[4]. The inner workings of the function which is called when the wave function collapses, may not exist in our universe. The randomness generator exists in the calculation of the simulation, but not the simulation itself. However, mathematical realism is conserved in the overall system, and the principle of local causality can be conserved as a law in the particular universe.

The probabilistic nature of QM may exist to allow for many different results from the same laws of the universe.

2.4 Error correcting codes

The discovery of error correcting codes in expression of the fundamental laws indicate that the laws of the universe are a result of an evolutionary process. The notable theoretical physicist, Jim Gates, has stated on Lex Fridman's AI podcast that, ' The craziest thing about these (error correcting codes) to me is that when you look at physics and try to write equations where information gets transmitted reliably, if you're in one of these super symmetrical systems with this extra symmetry, that doesn't happen unless there's an error correcting code present. So it is as if the universe says you don't really transmit information unless there's something about an error correcting code. This to me is the craziest thing that I've ever personally encountered in my research and it actually got me to wondering how this could come about because the only place in nature that we know about error correcting codes is genetics and in genetics we think it was evolution that causes error correcting codes to be in genomes. So does that mean that there was some kind of form of evolution acting on the mathematical laws of the physics of our universe? This is a very bizarre and strange idea and something I've wondered about from time to time since making these discoveries.'[5,6]

2.5 The basis for higher dimensional theories in an infinite dimensional universe

String theory and other ideas requiring higher dimensions are allowed in this system [7]. In the infinite space arbitrary dimensions can be used to store and work with data. This data can be called in the same manner as wave function collapse call in section 2.3. The human observer only interacts with the 4D space-time.

We live in 4D because these are the dimensions that were selected by the evolutionary process to increase the rate of reproduction of the data set.

2.6 Application to simulation theory

The simulation argument comes from the observation that completely different things such as silicon in computers can mimic the behaviour of a system that contains less information.

In this hypothesis the universe is an information processing system. So are all computer programs. Therefore the concept of the universe being a simulation does not seem significant [8].

3 Problems/ Required development

3.1 Information and interaction

This hypothesis makes no attempt to further the concept of information and interaction. These concepts require development so the four postulates can be posed in completely mathematical terms. A mathematical formulation of a constructor universe could explain the nature of interaction and consequently concepts such as time. The are existing endeavours which are somewhat related to these concepts. For example work by David Deutsch, Chiara Marletto, and collaborators in Oxford Physics on constructor theory [9]. Stephan Wolfram's theory of everything also seems to be relevant to these concepts[10], as these theories occur in a more basic formulation of space which has no assumptions completely based on an observer's view of reality.

The idea presented in this paper is these constructor theories would not immediately result in the universe we occupy. Instead, natural selection of reproducible structures in a constructor universe would result in our universe.

3.2 Falsifiability and similarities with biological evolution

This hypothesis is clearly not easily provable or disprovable, compared to theory such as Einsteins equations. However, it is the author's belief that this is a falsifiable theory. Evolution is traditionally a contentious theory in terms of falsifiability. This is demonstrated by Karl Popper's statements that it 'is actually a tautology' and that it 'contains no testable laws and is therefore a metaphysical research program' [11].

The nature of evolution and other numerically irreducible theories makes it difficult to make explicit predictions. Darwin famously struggled to give predictions to support his hypothesis. He did give one prediction of the existence of an animal with a foot long tongue, due to the existence of the orchid, Angraecum sesquipedale. The Xanthopan morganii praedicta(elephant-hawk moth) was later found to exist, verifying his prediction[12]. There is a small number other examples of explicit predictions from evolutionary theory such as work done by Richard D. Alexander [13].

The theory of evolution was therefore criticised for being a post-diction. The hypothesis presented here could similarly be classed as a post-diction, in terms of its relation to concepts like Planck's constant. A prediction given here, however, is that a 'theory of everything' will contain error correcting codes.

3.3 Non-competitive evolution

The current theory of evolution only concerns the biological application which is typically characterised by a competition for resources. This theory requires a concept of evolution in a non-competitive environment, with infinite resources.

4 Conclusion

The idea presented in this paper is that if sufficiently complex interaction of infinite data points in an infinite space existed, a reproducible structure would form. A universe with laws and properties such as our own would eventually develop in order to increase the rate of evolution. This is considered to be significant as is it considerably reduces the number of postulates required to create our universe when compared to the Big Bang (or a sentient entity such as a God).

The ultimate question to be answered is why something came from nothing. This question is not answered in this paper. It is the author's belief that the question, 'why does an infinite data space with the given postulates exist?' is considerably simpler than 'why does a universe described by numerous basic constants, laws of dynamics, principles and initial conditions exist?'

There is a significant amount of work to be done in the formulation of this hypothesis and in mathematical analysis and description of an infinite universe.

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