

FQXi Essay Competition
'It from Bit or Bit from It'

How Big a Bit of It are we?

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ABSTRACT

We point out the lack of any compelling evidence that mankind is of 'high' absolute intelligence, and the considerable evidence that Einstein was correct in suggesting that we understand almost infinitely little. We then examine the postulate that the universe is an experimental 'quantum computer' and that mankind is a minor incidental component in a complex and evolving quantum processing network. We visit the scenario and find that no evidence to the contrary stands examination. As the likely motivation implicit in that proposal is considered more likely than any other we conclude that It is from Bit.

Getting some idea of our relative scale within existence is difficult when we have no top or bottom limit to measure from. The 'Planck length' has been defined as a base dimension in relation to the physical part we can observe, but evidence exists that there is more that we cannot observe. Dark Energy is now an essential 'plank' of astrophysics and cosmology, yet within Max Planck's limit we find nothing. All matter just 'pops up' from this invisible energy pool initially as conjugate pair production, yet humankind is still in denial over the very existence of dark energy because we can't 'see it'. True the percentage of the mass-energy of the universe that Dark Energy represents has just been reduced from 72.8% to 68.3% by ESA's '*Planck*' findings, so in 50 years it may 'disappear'. Or will it? At the same time Dark Matter increased from 22.7% to 26.8%, so in 50 years we'd then be overwhelmed by it!

The point is that we 'know' absolutely nothing about dark anything, which we think makes up over 95% of the universe. How can we know if bit comes from it when we know almost nothing of it? For those who 'don't believe' in dark things they can't see lets consider what we CAN see. If real matter is mainly particles such as protons, what then is a proton made of? What do we 'know' of what we can 'see'? Including the stuff that makes ourselves? It may then easily be that Einstein was exaggerating when he estimated that "*we do not yet understand 1,000th of 1% of what nature has revealed to us*" It may well be that we really don't yet know 10^{-10} even of that 1,000th of 1%. But do we have to invoke a mysterious 'God' as a greater or the only intelligence? Even if we accept God there may be some intermediate intelligence that perhaps knows some 10^{30} times more than us but is not as 'all knowing' as what we normally assume a God should be.

Construction

Let us then imagine somebody a bit larger and brighter than we are now, technicians in a swish lab with a high-tech looking vacuum chamber which can be reduced to absolute zero degrees. We may need to close our eyes and grow until the universe is not longer visible, or 'quantum tunnel' to imagine the laboratory. The technicians have to conduct an experiment creating a new 'quantum supercomputer'. This may be thought of as an extension of Douglas Adam's Hitch-hiker's Guide scenario, where Earth was the computer, except that there is no Slartibartfast and as yet yet no 'universe'. The chamber is filled with the finest incompressible ethereal medium called '*Darkenagy*' at just below dew-point. Introducing one tiniest spinning particulate impurity then starts a chain reaction. For anybody unfamiliar, the dew-point of air is when it is so loaded with moisture vapour that any disturbance by matter or drop in temperature causes a droplet to condense. In a similar way, and where compressed locally, the medium in the chamber does the same, but as a vortex not a droplet of water.

Now the technicians know exactly what will happen at the initial perturbation and at what temperature, and the behavioural limits of the materials and process. The whole procedure is entirely causal and deterministic. An immensely powerful microscope is fitted to the chamber beside a window. A beautiful series of tiny vortices start to appear, spinning ever faster then contracting almost to a point before flowing out of the sides; re-emerging on a perpendicular axis and starting to rotate yet again on the new axis. Examining these closely the process can be seen as a fractal. Millions of vortices and billions of tinier vortices within each greater one, the process much faster at just a few nano seconds at the smaller scale so repeating four or five times in each main cycle.

The perception of time is then clearly different at a larger scale. Each one is slightly different and evolves differently within some known constraints. The fluctuations from the vortices travel very slowly through the medium, only at a certain speed c , but before long it can be seen that the chamber is full seeming to be filled by a fine diffuse cloud. Each tiny vortex is a universe, each filled with galaxies. The universe form self perpetuating almost infinite progression of orbital vector fields. Endless sensors are connected around the chamber walls. The computer processor is ready for duty. The fluctuation pattern can be read and information stored and processed in the vast orbital and rotational vector fields. If it takes a computer the size of the universe to predict the evolution of the universe then this is '*it*'.

Motivation

So what would be the motivation of the technicians? To simply store known data and recover it? Or to find out new things? A desktop computer can be just a tool, a symbol processor, and also a tap into a vast pool of information which somebody already knew but we did not. But, as in the Hitch-hikers Guide, it can also help us to answer questions that nobody yet knows the answer to. The conditions and rules of interaction of the universe may be set but perhaps still nobody yet knows precisely what outcomes will result. The ultimate complexity scenario. We may indeed then have 'determinism' without 'pre-determinism'. In our scenario the technicians have enough knowledge to know the materials and set the rules but no knowledge of the future outcome of such a complex system, where each interaction may be quite different.

Free Will

Lee Smolin among others has described all interactions between physical entities as unique events, so always unpredictable. Within our cerebral matrix then each interaction made would be new and may give a unique output. So can we have a deterministic system with set rules at the smallest scale but retain free will? The answer must consider semantics; So far we have purposely properly 'defined' nothing, and do so because each persons definition of each concept will be different, even if made of the same 'stuff' and following the same causal rules. If we define free will simply as the choices we see before us and our ability to select any one without outside influence, then undoubtedly we have unfettered free will.

Yet our choices are always limited, and in many ways. Physically of course (we can't fly without special equipment to help) but also within the 'visualisation' limits set by our neural network, which vary from network to network. So we have a limit on what we can 'imagine' as well, but as we can only imagine up to those limits we cannot see that constraint in any greater context. You may think you can now do so on reading this, but although each reader's mind will have been exploring new relationships and territory, all is well within those bounds.

So a definition of free will saying that we wish to do something we physically cannot is not met, and equally a proposition that we can 'think' or imagine limitlessly is false. In this case the starting conditions and rules of the supercomputer we may live in will have set unseen and unseeable limits. Again we have no evidence that in either relative or absolute terms we have any significant level of intelligence. It is only when judged by the standard of other creatures on our planet, where we may come a close second to dolphins, do we appear to have any clue at all as to what may be really going on. There can then be no conclusion drawn that apparent free will precludes that we are part of a 'computer' programme.

Quantum Uncertainty

So far all the evidence seems consistent with mankind being simply an incidental part of a great experiment. Yet now that scenario may seem to run into trouble. No mechanism or cause for quantum uncertainty appears to be available. Would not such clever technicians be expected to ensure removal of such experimental uncertainties? Yet the uncertainties are what makes the cloud what it is rather than some regular 'grid' structure, with so many unique actions. Uncertainty may then be said to be at the heart of the experiment, otherwise all universes may end up looking exactly alike! We can also freely assume that quantum uncertainty may also be implicit in the laboratory and technicians' own universe. So no recourse emerges there from the proposition of life as a qubit!

We try to retain a 'naturalist' philosophy in our considerations, which we equate with nature not following the rigid rules of mathematics. We do not then consider other flights of fancy (one is enough!) as we already have a 'multiverse' spatially. No other holographic or multiple existence concepts would seem able to evidentially either disqualify or support our thesis. The relationship between the 'classical', the 'quantum' and the 'natural' is however a difficult one to decide on. In some ways quantum uncertainty is the most natural part of nature, but the classical regime has traditionally laid claim to this territory. Uncertainty over uncertainty is partly to blame. There is confusion of choice of interpretations as to what quantum uncertainty really MEANS.

We wonder if we may take advantage of our temporary observer position to ask one of the technicians some questions. We find we can't speak, but 'think' the words anyway.

"Err, excuse me."

First the technician (T) looks round quizzically, checking nobody else is there, then seems to understand;

T; "Ahhh! ...Are you a quantum tunneller?"

"Hmm. Seems so. Do you have a moment for a few questions?"

T; "OK, but one. Just one. And if I were you I'd ask; "how am I getting back?"

"Oh! Is that a problem?"

T; "Yes, it is. It's a temporal thing I'm afraid, but as you asked, and you're the first one, I'll do a quick rewind for you before it's too late and let it run again. We have to get it right to the picosecond as time goes a bit quicker at your scale. Hold tight"

"But my question first right?"

T; "You've had it, 5 lines up. I can't tell you anything anyway. You'd corrupt the programme as the information you want can't become available to you unless you evolve to the right level."

"Oh. How long will that take?"

T; "Can't say. That's what this kit's for. To try to evolve something to that level. The probability is

almost zero, lower than tunnelling, but it must happen one day.”

“To us, I mean on my planet?”

T; “Same answer. What did you call it? ...your planet”

“Earth. ...do you know the Virgo super-cluster?”

T; “No, but I can find where you came from, I can see the blip, zooming in now.”

“So tell me, quantum uncertainty. Please. What's it all about?”

T; “Can't really say. It's not certain. Ah we have the right scale now. Look at that, is that 'Earth'?”

“Yes, ...beautiful isn't it. Can we zoom in more?”

The spinning picture on the screen was slowing. It was on it's side but with familiar outlines.

Sequences of tiny vortices were rushing across it.

T; “Of course we can. Tell me, are any of those vortices the same?”

“That's the weather, those ones are hurricanes, some are the same magnitude... but, well ...no.”

The planet's spin slowed almost to a halt

T; “Hmmm, the numbers don't look that promising. Still. Anything can happen, aaand ...Now!”

Back on Earth we ask; did that flight of fancy suggest anything we didn't already know? Was it complete nonsense? We may assume so but is there any evidence? Our proposition is that there is no more evidence for or against this scenario than for the universe as a hologram or for the creation of many worlds on a continuous basis. In terms of uncertainty what we may wonder is that; if all hurricanes, even of the same magnitude, are slightly different, then may all spin 'particles' not be slightly different at some scale below the Planck length too. Might any foundations of uncertainty need to be hidden far deeper than in the solid ground which we imagine and assume as the foundations of current science? Karl Popper proposed;

“Science does not rest upon solid bedrock. The bold structure of its theories rises, as it were, above a swamp. It is like a building erected on piles. The piles are driven down from above into the swamp, but not down to any natural or 'given' base; and if we stop driving the piles deeper, it is not because we have reached firm ground. We simply stop when we are satisfied that the piles are firm enough to carry the structure, at least for the time being.”

K. Popper, The logic of scientific discovery. Routledge, London/NY, 1992.

We propose that there is nothing to suggest that deep in those depths we may not find that we are part of a computer, and that our reality 'it' emerges from programme input 'bits'.

Implications

So what are computers for? For most of mankind computers have become games consoles. To others they are mainly portals for communication with others, or to find information via the internet. To many more perhaps just word processors. But at the leading edge computers run simulations to find what we don't know. The early popular computer was a calculator, asking endless '**what if's**' to derive a solution. The foundational purpose of a computer remains to give answers to '*what if*' questions, supporting the argument that the output is not pre-determined. The leap from the causality and determinism questioned by uncertainty to the future being 'predetermined' by some greater being has been seen as inevitable by many but is not so. But we must then next ask is any particular output 'inevitable'. Our answer is that all outcomes are possible but that no outcome is inevitable in any one case. If no two events are identical then no particular outcome can be known as it has not happened previously.

We then have an apparent dichotomy; Everything can happen, but nothing that happens has previously happened. This uniqueness of everything is counter intuitive but a logical conclusion of whatever scenario we wish to chose. We must then ask, is it more likely that, using the computer scenario;

- A. That we are a re-run of a long computer tape which is in a loop. ...Or
- B. That we are producing an original set of results and outcomes.

We propose that B is correct, in either the realistic *or* the computer view of the cosmos.

So what then is the difference? What would be the real implications of our human reality being 'only' a computer generation?

Our suggestion is; "*None*". We suggest that not only may we be result of some massively more complex analogy to what we call a 'computer', but that it makes no difference. In the 'algorithm' is a fundamental uncertainty of outcome which we call 'Quantum Mechanics', which goes far deeper than any reality we can observe. In terms of our conclusions about 'free will', of course we then have 'free will' to any extent we can discern. We're just not bright enough to discern much. In fact it appears that we are so dim in absolute terms that many genuinely believe that we're not!

Religion.

We now dare to briefly address the only subject in physics which can be considered more taboo by some belief systems than 'ether'. We claim to be rational beings. Let's look into that. Our science is stuffed full to the brim with anomalous findings, aberrations and paradoxes, yet so many still 'believe' in it. Are mice rational beings? Do we imagine that mice hold 'beliefs' as full of nonsensical and irrational concepts as ours. By that measure we may gain a better understanding of the Hitch-hikers Guide scenario where it was the *mice* who were responsible for the great computer, as they are far more 'rational' and thus intelligent than humankind! It may be nice to believe we are 'special', but we must deconstruct that concept, the evidence is only that we are 'unique', not 'better' in any absolute sense than what may have occurred before or after our existence.

So we must deal with the fact that we do not know all the facts, and **cannot** know all the facts. There is information which is unknowable to mankind. Religion is then simply one way of 'blocking off' the infinity that rational thought faces. Religions other than 'science' can have a similar effect if often lacking the shortage of a rationalised foundation. Considering the cosmos itself as a computer may be an equivalent strategy, giving rise to the implicit question of who 'built' it, so reverting to the same thing. We discuss this question further below. Approaching the question from another direction we may say that a God or Gods could have created the universe 'as' a computer. Again then the 'creation' may then reasonably have been to 'find out.' We conclude then that religion and creation is 'for all practical purposes' in the same class as computation. The important difference is then one only within our consciousness; how much nicer to consider there may be a benevolent benefactor behind our existence as a foundational limit to our consideration of what is 'knowable'. But we still conclude that as the technicians may have as much of a beneficial interest in our well being, then the two concepts are potentially equivalent.

What is a 'computer' anyway?

Ah, I never thought you'd ask! But you should now have been thinking about that long ago. Not to waste time and words, we suggest it could be *anything* designed by some outside intelligence and capable of an output (bit) derived and varying from an input. Many are also wondering what a 'quantum computer' really is. The answers are as inconsistent and disparate as interpretations of QM. Present computers are currently largely controlled by Gates. But new technology can bring in new players so one wonders what may happen when current processors are replaced by a new micro-software and hardware. Gates (and logic switches) may at last be out of the picture to be replaced by organics.

If we then use cloned or 'grown' brain tissue particle systems to act as processors, is that still a computer? You can see we may now be dangerously close to logically defining the human being as a computer. How much more intelligence and research work would it take before we

ourselves are able to create Data, the Star Trek version rather than just the bit? Perhaps not very far from a basic prototype we surmise. We have little reason to believe beings with superior intelligence to ours cannot exist, so we have little logical reason to believe we could not be an advanced quantum computer. We could then easily be grown from seeds of organic matter in the very short time taken. We seem then to be running out of falsifications.

Was the universe created from Bits?

Now we come down to the real question. It'd be all very well deciding human brains could be equivalent to computers, but the universe may be considered a slightly more impressive achievement. Studying at the smallest scale we, with our limited processing and observational power can imagine may be entirely inadequate. A proposition that matter consists of fluctuations of 'something' which we visualise as 'waves' seems reasonable. As a bit is considered as the 'up' or 'down' of a wave then John Wheeler may well have had reasonable cause to ask. But 'what IS waving?' For all our progress we're no closer to answering that question than when it was first asked. The waves may be made of waves made of waves, but ultimately there is a truth we may never prove equipped to discover. This is what we propose is the 'it', as opposed to the bits we can see. So may THAT 'it' be made from bits?

We must ask; is there a constraint on how big the smallest bits can be? Once we go beyond consideration of just the stuff we call 'matter', condensed from the stuff that's waving, then we can find little evidence to help. But all is not lost. We have some quite irrefutable evidence, if we discard extreme outlier theory, which is that, without knowing what it means, we do something that we describe with the word '**exist**'. So we have some relief, but can still offer no testament as to how small the 'stuff' may be. We are similarly unequipped to conceive of how LARGE the universe or some sort of multiverse may be, as the whole concept of infinity is entirely beyond our processing capability. In such a case then it may be only natural to resort to asking the question, "If stuff is here, then who put it here?" giving infinite reversion to religion, where the benevolent technicians may be as likely as the Gods envisioned by our forebears.

It from Bit or Bit from It.

So far we have not been able to provide any new evidence that we are not part of a computer. It's a score draw. So to avoid penalties we'll finally consider motivation, or 'purpose'. Who can we envisage may have the best purpose to create us, an all seeing God, in flowing robes or not, or some technicians who wish to discover something? We may even describe the two as the same, or some combined entity so as to avoid starting another religious war. But if we were created with a wave of a finger and a '*let there be light*', then why? The Bible seems to shed few EM oscillations on the subject. Yet if 'God' was only 'almost' all knowing, but wished to know more, (wouldn't anyone?) she might then think; "*Hmmm, what if...?*"

Hmm, now isn't that exactly how computers work?!

The only motivation available seems to be on the 'it from bit' side! But is that so bad? Would it not be far more satisfying to think we may be here for some great purpose that just to 'exist'? Just to live and die? We propose then that we are part of an immense computer constructed by a greater intelligence than us, yet looking to us for the answer. So we clearly conclude that, even if only as a matter of preference, the answer is; **It from Bit**.

Douglas Adams brilliantly found, when coming to the logical conclusion consistent with our own, that we then need to find the question. That found, we must then be original and identify some new questions; *What the hell is it? How small is our bit? and How big a bit of it are we?*