Is our Universe designed to constrain intelligence?

Tariq Khan
Omaha, Nebraska, USA

A short and informal philosophical and speculative essay noting how Universal constants, like the speed of light, and Dark Energy, Quantum uncertainty, and black holes, can be considered as constraints limiting both the total level of intelligence achievable in our Universe and the ability to store information into the far future by an intelligent being.

> *"Yet through their endeavor, men would glimpse the unimaginable artistry of Yahweh's work, in seeing how ingeniously the world had been constructed. By this construction, Yahweh's work was indicated, and Yahweh's work was concealed."*
> *-- Ted Chiang, Stories of Your Life and Others*

> *"There is a philosophical problem of some difficulty here, which I do not propose to discuss, but somewhere among all the possible combinations of letters that can occur are what one may call the real names of God. By systematic permutation of letters, we have been trying to list them all." ....*
> *"Wonder if the computer's finished its run. It was due about now."... He could just see Chuck's face, a white oval turned toward the sky. "Look," whispered Chuck, and George lifted his eyes to heaven. (There is always a last time for everything.) Overhead, without any fuss, the stars were going out."*
> *-- Arthur C Clarke, The Nine Billion Names of God*

> *"But the Lord came down to see the city and the tower the people were building. The Lord said, "If as one people speaking the same language, they have begun to do this, then nothing they plan to do will be impossible for them. Come, let us go down and confuse their language so they will not understand each other. So the Lord scattered them from there over all the earth, and they stopped building the city."*
> *-- Genesis 11:5-9*

> *"It may be beyond the limits of human intelligence to understand how human intelligence works."*
> *-- Noam Chomsky*

> *"The theory of inflation suggests that our universe is one of infinitely many that formed when the very early cosmos expanded exponentially. This picture of a multiverse, however, seems to destroy the theory's ability to make predictions because anything that can happen in an infinite multiverse will happen infinitely many times. The problem is solved, however, if the inflationary multiverse is equivalent to the "many worlds" interpretation of quantum mechanics, which posits that all these infinite universes coexist not in a single real space but in "probability space."*
> *-- Yasunori Nomura, Scientific American*

Much speculation exists as to why the Fundamental Constants of the Universe are what they are. Theories range from anthropic arguments to life or consciousness being a "goal" of the Universe, to multiverses, to simply random accident or chance. But perhaps those constants exist, as they are, in order to be a constraint i.e., a constraint on the amount of knowledge obtainable. Could the fundamental constants of the Universe and the a priori Laws of Physics, as we understand them, be "designed" to limit or constrain any conscious organism from obtaining omniscience or even extreme intelligence?

Consider a few features of the Universe. Dark Energy as a cosmological constant is not only causing the fabric of spacetime to expand (leading eventually in most theories to a "big rip" as even atoms are torn apart) but its rate of expansion is accelerating exponentially - in an interesting parallel to the growth rate of human knowledge. Human knowledge is thus limited by not being able to know anything beyond that cosmological horizon. The speed of light, as another constraint, ensures that light (information) from these regions can never reach us. Then, in the micro-world we have inherent limitations via Heisenberg's Uncertainty Principle and the Quantum Mechanical (if not holographic) Nature of Reality "at the bottom." In

terms of what can be stored, the Bekenstein Bound limits the amount of information that can be stored (within a spherical volume) to the entropy of a black hole with the same surface area – critically not its volume.

What about our limits of computation? Those limits (potentially excluding a real Quantum Computer) are known and limited by gravitational and thermodynamic constraints. As noted by MIT's Seth Lloyd here: https://arxiv.org/abs/quant-ph/9908043 and as summarized in the September 2000 New York Times article by George Johnson:

> Dr. Lloyd describes the ultimate laptop - a computer as powerful as the laws of physics will allow. So energetic is this imaginary machine that using it would be like harnessing a thermonuclear reaction. In the most extreme version of this computer supreme, so much computational circuitry would be packed into so small a space that the whole thing would collapse and form a tiny black hole, an object so dense that not even light can escape its gravity.

Let us illustrate further using the analogy that we are a person isolated in a room. We can never know our ceiling or walls as they expand away at an accelerating rate. We struggle to fully understand the floor of our room as it is in a fuzzy Quantum and indeterminate state (there is no cat or box in our room). Our attempts to signal to communicate outside the box are limited by the speed of light. As we build a super-computer to help in our efforts it eventually turns into a black hole on the floor of our room. After a trillion years, even our floor is ripped apart.

Consider the thought experiment of what could an advanced civilization do to try to ensure knowledge is passed on to a far future civilization. Is there any real way to guarantee the storage and fidelity of that information given these constraints? Monolithic stone pyramids will not suffice on these timescales. If one really wanted to store or communicate something to the future or far future, how would you do it? Some have suggested hide it in an algorithm that's entire goal is to survive i.e., hide knowledge in something like DNA. Perhaps store it in electromagnetic waves like radio or laser beams in outer space or at a Lagrangian point? But even these do not guarantee the effort in the long-term. Others have suggested a future civilization could arrange stars into a perfect triangle or do some type of similar cosmic-scale engineering but, again, stars die out and galaxies merge and spacetime expands. So how could this storage and communicating of information be done? The DNA argument seems interesting but likely storing complex knowledge is not its raison d'etre as DNA (and RNA) appear to have evolved before becoming information carriers for genomes. Even if an advanced civilization simply attempted to encode say the first one hundred digits of pi to proclaim their achievements to the deep future, they would likely fail. Nuclear decay, cosmic ray radiation, dark energy, and black holes will in the future or far future wipe out all their evidence.

Thus, is life or perhaps mental ideas or memes then the only mechanism to propagate information forward? Is our belief that intelligence is another Darwinian evolutionary advantage created for survival of a species perhaps inaccurate and is its "purpose" actually to store and retain knowledge in a Universe that appears built to constrain it? Are we missing something? Is life, all of life, actually just resiliency of memory i.e., data storage? Using modern Information Technology parlance, the Agile, Lean, or DevOPS analogy for a mobile and flexible data storage utility is thus a living reproducing being. But knowledge and consciousness occurred long after the creation of life and DNA molecules.

Now could there be a "benefit" for Dark Energy, Quantum randomness, and black hole annihilation preventing data resiliency and communication of knowledge? Are we witnessing a sort of imitation of ecosystem behavior and gene pools on earth where death has the gene pool "advantage" of preventing stagnation and ensuring variety and fecundity required for an optimal gene pool by preventing a pharaoh from living forever and owning 99% of all the resources in an ecosystem, nation, planet, or galaxy? Thus, universal constants (constraints) could be "designed" a priori in order to not allow an initial or even any intelligence from monopolizing an entire galaxy? Or perhaps the Universe been built to optimize variability to prevent excess knowledge i.e., "solving" it (consider Grand Unification Theories or a solution to Quantum Gravity) would make large areas stagnant (e.g., a machine using an entire galaxy for power or any intelligence or AI out of control turning everything into paperclips). Thus those a priori constants of gravitational strength, pi, Dark Energy lambda expansion rate, Plank's H-bar constant, etc. are all set to specific values in order to ultimately prevent galactic inequality and stagnation. Is this a possible clue that "Nature," in terms of aggregate life on earth, is not only a distributed intelligence but also perhaps that Universe itself? In this vision, the Universe prevents any intelligence from learning and communicating too much and having too

much power. Obviously, the level of anthropomorphism here is large, but it is used for the point of the discussion. Perhaps this intimates that the "point of life," like Douglas Adam's famous quote about "dolphins mucking around in the water," is to simply enjoy life and not try to answer all questions? One could argue trying to achieve maximum knowledge is a "waste of time" as various life forms must thus repeat the painful learning steps over and over to avoid that education becoming lost forever. Or perhaps we can interpret the inherent lack of long-term storage, fidelity, and perfect knowledge as implying that there is no need to do this "inside" our Universe since it is all "stored" via our brain into a Platonic Universe (a meta-verse of forms and ideas and infinity as envisioned by the eponymous ancient Greek)? Such dreams buttress metaphysical beliefs in an after-life or that our Universe is simply a "dream" or a simulation or programmatic runtime instance with an "external" something "gathering," testing, or comparing results but that also has no need for the internal program to run for so long that its simulations can become omniscient. In such a scenario, the "programmer" thus constrains storage and communications via horizons (speed of light and dark energy) and boundaries black holes and quantum indeterminacy.

There is, of course, the goal of creating a true Quantum Computer. The philosophical point related to its creation is best described by physicist Paul Davies in his chapter called Universe from Bit in the 2010 book Information and the Nature of Reality:

> The conclusion is stark. If the cosmic information bound is set at 10^{122} bits, and if information is ontologically real, then the laws of physics have intrinsically finite accuracy. For the most part, that limitation of the laws will have negligible consequences, but in cases of exponentiation, like quantum entanglement, they make a big difference, a difference that could potentially be observed. Creating a state of 400 entangled quantum particles is routinely touted by physicists working on building a quantum computer (their target is 10,000 entangled particles). I predict a breakdown of the unitary evolution of the wave function at that point, and possibly the emergence of new phenomena. To quote Wittgenstein (1921): "Whereof one cannot speak, thereof one must remain silent." We cannot - should not - pronounce on, or predict, the state or dynamical evolution, of a generic quantum system with more than about 400 entangled particles, because there are not enough words in the entire universe to describe that state (pg. 109).

Could the Universe's ultimate circuit-breaker action be that of knowledge containment i.e., prevention of omniscience? Perhaps Paul Davies' noted experiment result will add insight. Perhaps there is a Platonic Universe that is the only infinity and then, by a sort of cosmic "no-cloning rule" or definition, it is the only reality of infinite storage or knowledge or as you approach it you then, by definition, fail (a la Paul Davies experiment) or is our entire Universe then ripped apart by Dark Energy or do we just simply become i.e., merge with, the Platonic realm? At this point we are well beyond metaphysical speculation. Speculating further in this realm of fantasy, perhaps the reason we have never encountered an extremely advanced alien intelligence is that whenever an intelligence becomes so advanced, as to approach omniscience, it causes the Universe to "reboot" or self-destruct akin to a circuit-breaker action? Perhaps the design of the Universe we have with its constants and constraints and aforementioned features are additional indicators of our reality being a computational runtime or instance or simulation after all.