The Informational Derivation of Reality: Consciousness, Time, and Substrate Independency

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Abstract

We show that humans must be formal axiomatic systems if only four assumptions hold. From this, we proof that simulated humans must instantiate subjective experience, and time is not a fundamental property of the universe but an emergent, internal property of the observer. We derive that the computer and the simulated observer are not causally related, but merely different arrangements of information. From these we show that the universe is fundamentally abstract and substrate-independent, emerging from information rather than from a physical substrate. The resulting claims are falsifiable.

1 Axiomatic Premises

The argument begins with four axioms that serve as the premises for the entire derivation.

Axiom 1: Genetic Encoding of Subjective Experience

DNA is the blueprint of a conscious, pain-sensitive human.

$$A_1 : D \rightarrow H \rightarrow S$$

(Where D is the DNA/Genome, H is the human organism, and S is subjective experience.)

Axiom 2: Physicality and Axiomatic Law

DNA, the human organism, and the surrounding environment are composed solely of ordinary physical matter governed by physical laws (P).

$$A_2 : (H, U) \in \text{Axiomatic System}(P, D)$$

(Where U denotes the physical environment required to support H, and P denotes the governing physical laws.)

Axiom 3: Generalized Church-Turing Thesis Holds

Any physically realizable process that can be described mathematically can, in principle, be simulated by a computational system.

Axiom 4: Pain Affects Behavior

A human with subjective experience (S, e.g., pain) behaves differently than the same human without it.

$$H + S \neq H$$

If a simulation H' is identical to H in behavior, it must also include S.

2 Deduction 1: Substrate Independence and Time as an Internal Property of the Observer

2.1 The Optimization Argument

Consider a DNA simulation running on a computer, denoted by T_{alg}, consisting of code (the laws of physics) and data (the state of the simulated universe). One can gradually optimize the code by introducing lookup tables, eventually replacing all computation with a static, precomputed dataset, denoted by T_{data}.

- Let E_{int} be Alice's experience of time and pain (the internal state transitions).

- Let E_{ext} be the computer's external runtime (number of CPU cycles).

Premise: Code optimization changes E_{ext} but preserves E_{int}.

$$\text{Optimization}(T_{\text{alg}}) \to T_{\text{data}} \implies E_{\text{int}}(T_{\text{alg}}) \equiv E_{\text{int}}(T_{\text{data}})$$

In this limit, the external runtime E_{ext} becomes zero in the sense that no state transitions are executed; the complete execution trace exists as static data. One can therefore ask: does Alice's consciousness still persist in T_{data}?

If consciousness were to cease in T_{data}, it would necessitates a minimum code/data ratio for subjective experience. This minimum ratio would be a new, non-physical constant imposed on A_2, leading to a contradiction.

> **Conclusion:** Consciousness can emerge from pure static data. Time and subjective experience (S) must emerge solely from information.

2.2 The Multi-threaded Argument

Consider a multi-threaded computer running two DNA simulations, τ_A (Alice) and τ_B (Bob), concurrently, with a minimal time slice of one CPU cycle per thread. The execution trace of the computer is then an interleaved sequence of segments drawn from both τ_A and τ_B. As the number of threads (simulated observers) increases without bound, the resulting execution trace asymptotically approaches white noise. Consequently, each bit originating from τ_A are separated by increasingly large intervals of unrelated data.

Is Alice still conscious in this limit? If one maintains that E_{int} vanishes as the number of threads increases, one must define a specific thread density or bit-contiguity threshold required for subjectivity. Such a threshold would constitute a new physical constant, which contradicts the completeness of A_2.

Conclusion: Conscious experience can arise from static white noise.

3 The Functionalist Proof by Contradiction

1. **Assumption (Objection):** A simulation H' exists such that $H' \equiv H$ (physical/behavioral equivalence) but $S(H') = \emptyset$ (lacks consciousness/sense of pain) [1].

$$\text{Behavior}(H') = \text{Behavior}(H) \wedge S(H') \neq S(H)$$

2. **Premise:** From A_4, the behavior of H is a function of its physical inputs **and** its subjective experience: $\text{Behavior}(H) = f(\text{Inputs}, S)$.

3. **Contradiction:** If the behaviors are identical despite the difference in S, then S must not be a necessary input to the function f.

4. **Violation of Axiom:** If S is not necessary to produce the behavior, then S is epiphenomenal (causally inert). This directly contradicts A_4.

Conclusion: To maintain the integrity of A_4 within the axiomatic system, the simulation H' must experience subjective time and pain.

4 Falsifiability of the Hypothesis

The hypothesis is falsifiable in the future when technology advances and DNA simulations can be run with sufficient accuracy for DNA-based organisms. The effect of pain can be measured just like an effect of physical forces can be measured. If a DNA simulation H' is constructed and shown to lack S, then A_4 is invalidated, and the axioms 1–3 collapse.

Discussion

4.1   The Hollow Simulation Objection

A common objection to functionalist and computational accounts of mind is the so-called *hard problem of consciousness* [1]. In this context, it is often claimed that a simulated human, even if behaviorally and functionally identical to a biological human, could nevertheless be "hollow"—that is, it could lack subjective experience while still producing identical outward behavior.

Formally, this objection asserts the possibility of a system H' such that

$$\text{Behavior}(H') = \text{Behavior}(H) \quad \text{and} \quad S(H') = \emptyset,$$

where H is a biological human and S denotes subjective experience.

By Axiom 2, the biological human H is a formal axiomatic system whose state transitions are fully determined by physical law and initial conditions. By Axiom 3, there exists a formal representation H' whose execution trace is isomorphic to that of H, preserving all causally relevant internal relations. By Axiom 4, subjective experience is a causally efficacious component of the system, contributing to observable behavior.

If H' were to lack subjective experience while remaining behaviorally identical to H, then subjective experience would not be a necessary input to the causal function generating behavior. This would render subjective experience epiphenomenal, directly contradicting Axiom 4.

4.2   Quantum Computers

We have considered two thought experiments run on classical computers. If conscious experience can be duplicated on classical computers, we argue it can also be duplicated on quantum computers. This follows directly from substrate independence: quantum computation represents an alternative physical realization of the same formal state-transition structure.

Numerical Precision

As long as physical laws are instantiated with sufficient fidelity for DNA and organismal processes to operate, the observer remains conscious.

Let ϵ denote the numerical error in simulating physical law. As long as $\epsilon \leq \epsilon_{\text{DNA}}$, sufficient to reproduce all DNA-mediated processes, the simulated observer H' remains conscious; any smaller $\epsilon_{\min}$ required to preserve consciousness would constitute a new physical constant, contradicting A_2:

$$\epsilon \leq \epsilon_{\text{DNA}} \implies S(H') \neq \emptyset$$

5 Conclusions

- **Substrate Irrelevance:** The universe is fundamentally informational and abstract rather than substrate-dependent.

- **Time:** Time is not an attribute of (E_{ext}) but emerges solely as an internal property (E_{int}) of the observer.

- **Emergence from Noise:** Information that appears random can encode an universe containing a conscious observer.

- **Ontological Equivalence:** There exists $2^n - 2$ other configurations, potentially describing conscious observers.

By treating subjective experience (S) as a property of an axiomatic system, we move from metaphysical speculation to a rigorous informational mechanics.

References

[1] David J. Chalmers. *The Conscious Mind: In Search of a Fundamental Theory*. Oxford University Press, 1996.