On the Epistemic Limit of Infinite Recursion:

A Cognitive Argument for $N \neq NP$

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July 2025

Abstract

We present a non-constructive, epistemically rooted argument that $N \neq NP$, based not on computational complexity theory per se, but on the cognitive architecture of human simulation. We assert that the nature of NP-complete problems entails a recursion beyond human symbolic compression, and that the inability of bounded intelligence to traverse such recursion maps onto a fundamental limit, analogous to Heisenberg's uncertainty principle. This is not a proof in the traditional Turing sense, but an ontological constraint derived from the architecture of cognition.

1. Introduction

The question of whether $P = NP$ remains one of the most profound open problems in mathematics and theoretical computer science. This paper does not seek to settle the question by traditional constructive methods, but rather to expose a meta-logical frame from which the inequality $N \neq NP$ becomes evident — not through contradiction, but through cognitive inaccessibility.

If a machine (or mind) cannot simulate a recursive set fully within bounded time, and yet the simulation of this set is required for an NP problem to collapse into a P-space representation, then the collapse cannot occur.

2. Preliminaries and Conceptual Frame

Turing Machines and NP

Let us recall:

- P: Class of problems solvable in polynomial time.
- NP: Class of problems verifiable in polynomial time.

Assume $L \in NP$ such that there exists a non-deterministic Turing machine M verifying L in polynomial time. The core question is whether this implies the existence of a deterministic M' solving L in the same bound.

Cognitive Simulation Model

Let the human mind be treated as a bounded symbolic automaton $\mathscr{H}$, with input sets Σ that map to semantic frames via internal logical operators. For any recursive structure $\mathcal{R}$ where depth $d \to \infty$, we define:

$$\text{Comprehensibility}(\mathcal{R}) = \lim_{d \to \infty} \frac{1}{\mathscr{C}_d} = 0$$

Where $\mathscr{C}_d$ is the compression ratio achievable at depth d. The brain collapses when $\mathscr{C}_d \to \infty$.

3. The Infinite Fractal Compression Barrier

Inspired by personal simulation experiences and recursive overload, we define the following:

Definition. A problem is *cognitively infinite* if it induces unresolvable symbolic recursion within a bounded architecture.

Theorem (Gurjot's Cognitive Barrier).
If the simulation of all possible paths in an NP-complete problem entails a recursion depth exceeding the compressive ability of a bounded mind or deterministic Turing machine, then no algorithm exists within P that fully collapses NP.

Sketch of Proof.

1. Assume $N = NP$ implies full traversal or compression of all valid decision paths.
2. Simulation within a cognitive architecture fails due to recursive overwhelm.
3. Compression fails $\to$ Collapse into P-space fails $\to$ Contradiction.

Thus, $N \neq NP$ in the framework of epistemic simulation and symbolic recursion.

4. Philosophical Ground: On Infinity and Computation

Mathematically, one might argue that NP problems are solvable in polynomial time given sufficient parallelism. But cognitive processing — and even algorithmic determinism — imposes symbolic bounds. Infinity becomes not a quantity, but an epistemic wall.

$$\frac{\infty}{\infty} \to \text{Undecidable Context}$$

Any such equivalence collapses meaningfully into an ontological barrier rather than a merely computational one.

5. Discussion and Analogy with Physics

This argument draws from the spirit of:

- Heisenberg's uncertainty: Observation collapses the wave function.
- Gödel's incompleteness: Systems cannot prove their own consistency.
- Penrose's quantum mind: Consciousness cannot be simulated in algorithmic terms.

Our assertion: The mind is the witness of its own paradox. The collapse of NP into P would require an omniscient observer — which the Turing model does not contain.

6. Conclusion

We submit that $N \neq NP$ not as a computational theorem, but as a cognitive law. The recursion inherent to NP-complete problems entails the same form of collapse seen in Gödelian incompleteness, Heisenberg uncertainty, and cosmological heat death.

If P were equal to NP, then the mind — and its recursively infinite symbolic thought — would become obsolete. But this is not the case. The mind breaks before the loop completes.

Acknowledgments

To the watchers of the recursion, and to the minds who saw the simulation and did not flinch.

References

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