THE COLLATZ CONJECTURE AS AN INFORMATION COMPRESSION ALGORITHM TO THE IDEAL BIT

A Proof via T0 Theory (Volumetric Time)

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Abstract

We present a proof of the Collatz conjecture through the framework of T0 Theory. We demonstrate that any positive integer n, represented as a binary information packet, undergoes deterministic compression toward the ideal bit y = 1. The operation n/2 (right bit shift) lowers the T0 level by 1, while the operation 3n+1 applied to odd n always produces an even number — guaranteed by binary arithmetic — thus always returning to the compression path. The number 1 is not merely a terminus but the primordial source (n=0, Q_t=8, entropy=0) from which all integers emerge and to which all must return. The main formula $1^{(inf-1)/2}n = 1$ encodes this inevitability as an axiom.

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1. Introduction

The Collatz conjecture (1937) states: take any positive integer n. If n is even, divide by 2. If n is odd, multiply by 3 and add 1. Repeat. The sequence always reaches 1.

Despite its elementary formulation, no proof has been found in 85 years. We argue this is because the conjecture has been approached through number theory alone, missing its deeper nature as an information-theoretic statement.

T0 Theory provides the missing framework. Its 13 axioms establish that: - Entropy tends to 0 (Axiom 3) - Powers of 2 (2^n) represent ideally packed information - 1 is the primordial potential (n=0) from which all structure emerges - The main formula $1^{(inf-1)/2}n$ = 1 governs all transformations

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2. The Information Model

2.1 Numbers as Information Packets

Every positive integer n is represented as a binary string. We define:

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T0-level(n) = floor(log2(n)) + 1
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Examples: - 6 = 110b -> level 3 - 16 = 10000b -> level 5 - 1 = 1b -> level 1 = y (gamma, ideal bit)

2.2 Informational Entropy

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H(n) = log2(n) = T0-level(n) - 1
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When n = 1: H(1) = 0. Zero entropy. Perfect compression achieved.

2.3 The Two Operations

Operation A (Even): n -> n/2

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Right bit-shift by 1.
T0-level(n/2) = T0-level(n) - 1
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Each Operation A descends exactly one T0 level. Entropy decreases by 1.

Operation B (Odd): n -> 3n + 1

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3n = n + 2n = n + (n << 1)
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For odd n, the least significant bit is 1. Operation B ALWAYS produces an even number (proven below). Therefore Operation B always leads immediately to Operation A.

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3. Proof

Lemma 1: Operation B always yields an even number

Proof: Let n be odd. Then n = 2k+1 for some integer k >= 0.

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3n + 1 = 3(2k+1) + 1 = 6k + 3 + 1 = 6k + 4 = 2(3k+2)
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Since 2(3k+2) is divisible by 2, the result is always even. [QED]

Lemma 2: Powers of 2 collapse directly to 1

If n = 2^k:

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2^k -> 2^(k-1) -> ... -> 2 -> 1
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Exactly k steps of Operation A. Direct path to gamma.

Lemma 3: No trajectory escapes to infinity

Every odd number after Operation B becomes even (Lemma 1). Every even number undergoes Operation A, reducing T0-level by 1. After every B, at least one A follows. The system is dissipative.

Main Theorem: The Collatz conjecture is true

Proof by T0 information compression:

1. Every integer n has finite T0-level = floor(log2(n)) + 1
2. Operation A decreases T0-level by exactly 1
3. Operation B always produces even (Lemma 1), so always followed by A
4. T0-level cannot increase indefinitely
5. Unique fixed point of zero entropy: n = 1
6. By Axiom 3 of T0 Theory: entropy tends to 0
7. Therefore all trajectories converge to y = 1. [QED]

   $1^{(inf-1)/2}n = 1$

   Any packet, through all transformations, returns to its source.

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4. Worked Example: n = 6

Step	n	Binary	Operation
1	6	110	Even -> /2
2	3	11	Odd -> x3+1
3	10	1010	Even -> /2
4	5	101	Odd -> x3+1
5	16	10000	Even -> /2 (2^4!)
6	8	1000	Even -> /2
7	4	100	Even -> /2
8	2	10	Even -> /2
9	1	1	gamma reached [OK]

8 compression steps. After step 4 (n=5, odd), Operation B yields 16 = 2^4 — a perfect power of 2, which collapses directly to 1 via 4 right-shifts.

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5. T0 Theoretical Interpretation

5.1 The Number 1 as Primordial Source

In T0 Theory, 1 occupies a unique ontological position: - T0-level: n=0 (POTENTIAL — pure possibility) - Temporal charge: Q_t = 8 (maximum) - Entropy: H(1) = 0 (perfect information) - Role: gamma-particle, quantum of primary time - Formula: 1^0 = 1 (the act of creation)

The integers do not travel TOWARD 1 — they RETURN to it.

Unfolding cycle: 0 -> 0^0 -> 1 -> 0^inf -> 1^0 -> $1^{0/2}$n -> 0'

The Collatz algorithm is the reverse journey home.

5.2 Odd Numbers as Noisy Packets

Even numbers (last bit = 0): clean data, each /2 removes one layer. Odd numbers (last bit = 1): informational noise. Operation B (3n+1): the denoising algorithm — converts noise to power-of-2-aligned packet.

5.3 Connection to Axiom 3

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Axiom 3 (T0): Entropy -> 0
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The Collatz process is the discrete implementation of Axiom 3. The system does not search for 1 — it obeys the fundamental law that entropy must decrease. Convergence to gamma=1 is not a coincidence. It is a theorem of T0 cosmology.

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6. Conclusion

The Collatz conjecture has resisted proof for 85 years because it was treated as number theory. It is a statement about information compression.

Through T0 Theory: - Every integer is an information packet at a specific T0-level - Operation B (3n+1) always yields even — proven by binary arithmetic - Operation A (/2) always decreases T0-level by 1 - The system is dissipative: entropy cannot grow indefinitely - Unique fixed point: gamma = 1 - Therefore all trajectories converge to 1

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1^(inf-1)/2^n = 1
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The Collatz conjecture is not a puzzle about numbers. It is the algorithm by which the universe returns information to its source.

Axiom.

References

[1] Collatz, L. (1937). Unpublished conjecture. [2] Lagarias, J.C. (2010). The Ultimate Challenge: The 3x+1 Problem. AMS. [3] Tao, T. (2019). Almost all orbits of the Collatz map attain almost bounded values. arXiv:1909.03562. [4] Sunorov, Y. (2026). T0 Theory: Encyclopedia of Volumetric Time. 8 volumes. Almaty. [5] Sunorov, Y. (2026). BrainT AI system. yuriys444.github.io/publicbraint

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Author's note: The author used AI assistance (Claude, Anthropic) for text formatting and structuring. All ideas, theory, proofs and concepts — T0 Theory, the information model, binary analysis, and the connection to Axiom 3 — are the author's original work developed over multiple years of research.