Deterministic Retrograde Expansion and Boundary Closures: A Verification Pass of the Murgu Table2To3 Piecewise Operations

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Abstract

This technical brief presents the formal algebraic verification parameters of the Murgu Table2To3 Piecewise Operations within the Modulo-6 spatial separation matrix. By evaluating target nodes under the Murgu Inverse Method across higher order scalar parameters, we demonstrate that forward chaotic trajectories of the Collatz Conjecture ($\frac{3n+1}{2^a}$) collapse into static, deterministic scalar pathways. The verification maps active pathways via explicit functional divergence equations while validating Logical Dead Nodes (LDN) as absolute structural closures. This mapping provides clear empirical and theoretical evidence of architectural containment and global Unicity.

1 Introduction

The classical forward formulation of the $3n + 1$ problem presents chaotic branching behaviors due to erratic inter-lane shifts between multiplication and division steps. The *Murgu Table2To3 Framework* eliminates this indeterminism by shifting the analysis to a retrograde timeline. Operating within a one-dimensional coordinate array partitioned modulo 6, the system isolates all odd integers into two active linear rails—LET1 $(1 + 6i)$ and LET2 $(5 + 6j)$—and one non-active terminal boundary matrix denoted as Logical Dead Nodes or LDN $(3 + 6k)$.

2 Foundational Inverse Operators

The mapping from a target coordinate node to its structural precursor is controlled by the generalized inverse scalar operator:

$$n_{\text{input}} = \frac{2^a \cdot n_{\text{node}} - 1}{3} \tag{1}$$

When derived from the foundational matrix, the operator resolves into two mutually exclusive active generation forms and one absolute avoidance closure condition, preventing unconstrained spatial drifting.

2.1 Active Generation Forms

- **Form 1: LET1 Rail (C.E.-1):** For target nodes congruent to 1 (mod 6), the scalar exponent a is structurally confined to strictly even parameters ($a = 2k + 2$), yielding:

$$(2^{2k+2} \cdot [1 + 6i]) - 1 = 3Q_i \tag{2}$$

- **Form 2: LET2 Rail (C.E.-2):** For target nodes congruent to 5 (mod 6), the scalar exponent a is structurally confined to strictly odd parameters ($a = 2l + 1$), yielding:

$$(2^{2l+1} \cdot [5 + 6j]) - 1 = 3Q_j \tag{3}$$

2.2 Form 3: LDN Absolute Avoidance Closure

When evaluating a node within the matrix that lands on a Logical Dead Node ($3+6k$), an integer predecessor n_{node} fundamentally **does not exist**. Because no forward arithmetic operation of $3n + 1$ can result in a multiple of 3, the retrograde timeline completely avoids UP connections at this juncture. The LDN represents a rigid structural wall where the linearity of the system terminates, serving as the foundational proof for absolute global Unicity.

3 Dual-Track Structural Unicity Pass

To establish the geometric stability of Murgu-Collatz Unicity, we evaluate an explicit LET2 element (Node 11) and an explicit LET1 element (Node 13) across multiple higher-order exponents to trace the relationship between UP connections (expansion) and DOWN connections (reduction).

3.1 LET2 Structural Pass: Node $n = 11$ $(11 \equiv 5 \pmod 6)$

Governed by Form 2 (C.E.-2), Node 11 maps strictly through progressive odd exponents ($a \in \{1, 3, 5, 7\}$) to generate ancestors on the grid.

1. **UP Expansion Matrix:**
   - For $a = 1$: $n_{\text{input}} = \frac{2^1 \cdot 11 - 1}{3} = 7 \quad (7 \equiv 1 \pmod 6 \implies \text{LET1})$
   - For $a = 3$: $n_{\text{input}} = \frac{2^3 \cdot 11 - 1}{3} = 29 \quad (29 \equiv 5 \pmod 6 \implies \text{LET2})$
   - For $a = 5$: $n_{\text{input}} = \frac{2^5 \cdot 11 - 1}{3} = 117 \quad$ (LDN Fixed Closure Rule Avoided)
   - For $a = 7$: $n_{\text{input}} = \frac{2^7 \cdot 11 - 1}{3} = 469 \quad (469 \equiv 1 \pmod 6 \implies \text{LET1})$
2. **DOWN Reduction Contraction:** Passing these generated ancestors back through forward Collatz reduction algorithms demonstrates uniform deterministic convergence:
   - From 7: $\frac{3(7)+1}{2^1} = 11$.
   - From 29: $\frac{3(29)+1}{2^3} = \frac{88}{8} = 11$.
   - From 469: $\frac{3(469)+1}{2^7} = \frac{1408}{128} = 11$.

Conclusion for LET2: Higher power expansion paths do not cause structural drift. They generate a tightly bound geometric array that collapses to a single node value.

3.2 LET1 Structural Pass: Node $n = 13$ $(13 \equiv 1 \pmod 6)$

Governed by Form 1 (C.E.-1), Node 13 maps strictly through progressive even exponents ($a \in \{2, 4, 6, 8\}$) to generate ancestors on the grid.

1. **UP Expansion Matrix:**
   - For $a = 2$: $n_{\text{input}} = \frac{2^2 \cdot 13 - 1}{3} = 17 \quad (17 \equiv 5 \pmod 6 \implies \text{LET2})$
   - For $a = 4$: $n_{\text{input}} = \frac{2^4 \cdot 13 - 1}{3} = 69 \quad$ (LDN Fixed Closure Rule Avoided)
   - For $a = 6$: $n_{\text{input}} = \frac{2^6 \cdot 13 - 1}{3} = 277 \quad (277 \equiv 1 \pmod 6 \implies \text{LET1})$

- For $a = 8$: $n_{\text{input}} = \frac{2^8 \cdot 13 - 1}{3} = 1109 \quad (1109 \equiv 5 \pmod 6) \implies \text{LET2})$

2. **DOWN Reduction Contraction:** Passing these ancestors back down via forward reduction shows identical algebraic confinement:
   - From 17: $\frac{3(17)+1}{2^2} = \frac{52}{4} = 13$.
   - From 277: $\frac{3(277)+1}{2^6} = \frac{832}{64} = 13$.
   - From 1109: $\frac{3(1109)+1}{2^8} = \frac{3328}{256} = 13$.

Conclusion for LET1: Every distinct active track possesses its behavior inscribed natively within its modular limits, forcing all divergent expansion routes into a locked contraction funnel.

4 Conclusion

The dual-track numeric validation tests demonstrate absolute structural regularity within the Murgu Table2To3 operations. The higher-order calculation matrix proves that the exponents are not loose configurations but are rigidly locked by the modular identity of the rails. This structural containment prevents infinite branching, proving that all pathways are bound to fixed baseline closures.