Concept Flyer — Structural Primality

Reinterpreting Prime Numbers Through Structural Closure

Shunyaya Structural Universal Mathematics — Structural Primality

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Caution: Research / observation only. Not for cryptographic or real-time decision-making.

The Problem: What Is a Prime, Structurally?

Classical number theory defines a prime as an integer greater than 1 with no divisors other than 1 and itself.
This definition is binary and correct, but it is silent about *how* composites fail and how close an integer is to factorization.

Structural Primality reframes primality as a **structural non-closure condition**.

Instead of asking:
"Is `n` divisible?"

It asks:
"Does `n` structurally close under bounded divisors?"

Structural primes are **definitionally** identical to the classical primes; this framework adds observational metrics without changing classification.

The Rule: Structural Closure Test

For each integer `n >= 2`, define the bounded divisor set:

```
D(n) = { d | 2 <= d <= floor(sqrt(n)) }
```

A structural closure occurs if there exists a `d` such that:

```
n mod d = 0
```

- closure exists → `n` is **COMPOSITE**
- no closure → `n` is **STRUCTURAL_PRIME**

This preserves exact classical equivalence:

- all classical primes are structural primes
- no composite is misclassified

The distinction lies not in correctness, but in **structural observability**.

Structural Metrics

Beyond classification, Structural Primality records *how* closure occurs.

For composites:

- **closure_d**: smallest divisor causing closure
- **closure_a**: normalized alignment value

For all integers:

- **closest_d**: nearest divisor candidate
- **closest_band**: discretized proximity band

Structural Bands

Proximity is partitioned into ordered bands:

```
A, B, C, D, E, F
```

Where `A` is closest to closure and `F` is farthest.
Structural primes occupy bands without closure.

What the Computation Evaluates

All integers from `2` to `N` are evaluated using:

- deterministic logic
- SPF or trial division engines
- no randomness or approximation

Each integer yields a classification and a reproducible structural footprint.

Key Findings (N = 100,000)

Classification Integrity
• Structural primes: 9592
• Composites: 90407
• Exact match with classical prime counts

Structural Distribution
• Most integers cluster in Band A (dominated by even composites)
• Structural primes concentrate primarily in Bands B and C, with presence extending into D
• Higher bands are sparse and structurally significant

Composite Closure Depth
• closure_d = 2 dominates (even numbers)
• Higher closure depths decay rapidly
• Distribution is heavy-tailed and non-uniform

Prime Density by Range
• Evaluated using finite, configurable bucket sizes (e.g., 1000)
• Prime ratios decay smoothly with increasing n
• No anomalies or discontinuities observed

What Structural Primality Reveals

Structural Primality shows that:

- compositeness is hierarchical, not uniform
- factorization pressure varies structurally
- primes resist closure rather than merely avoiding divisibility

Primality is not just the absence of divisors.
It is **resistance to structural closure**.

Deterministic and Auditable

Structural Primality is:

- fully deterministic
- reproducible across machines
- auditable at the row level

Identical inputs always yield identical classifications, closure depths, and bands.

What Structural Primality Is (and Is Not)

Structural Primality **is**:

- a finite, exact reinterpretation of primality
- a structural observability framework

Structural Primality **is not**:

- a new definition of primes
- a probabilistic test
- a cryptographic substitute
- a factorization shortcut

It does not replace classical theory.
It reveals structure classical theory does not record.

Why This Matters

Structural Primality introduces:

- measurable structure into primality
- geometry-like intuition in arithmetic
- new axes for analyzing integers

Relevant for:

- mathematical education
- structural number analysis
- algorithmic diagnostics
- foundational research

Even settled concepts yield new insight when examined structurally.

Finite integers. Exact rules. Structural visibility.

OMP