

# Combinatorial Logic of Continued Fractions

Discrete Mathematics of Neural Repair

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*Verified Verification: Near Real-Time Simulation Engine v3.0*

# Combinatorial Analysis of Neural Repair

## The Discrete State Space

Neural repair is modeled as a walk on a Cayley tree. The path to recovery is a sequence of decision nodes in the plasticity landscape.

We map this discrete path to a continued fraction expansion, providing a unique representation of the repair trajectory.

## Chapter 2

# Formal Derivation of Convergence

## Continued Fraction Representation

The connectivity index  $C(t)$  at time  $t$  is given by the finite continued fraction:

$$C(t) = a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \dots + \frac{1}{a_n}}}$$

## Convergence Theorem

Theorem 1: If the coefficients  $a_n$  satisfy  $a_n \geq 1$  for all  $n$ , the fraction converges linearly. If  $a_n$  grows exponentially (as in our Hebbian model), convergence is super-linear.

$$|C - p_n/q_n| < 1 / (q_n * q_{n+1})$$

## Chapter 3

# Renormalization Group Flow

## Scaling Laws

The repair process exhibits self-similarity. We apply Renormalization Group (RG) transformations to coarse-grain the neural network.

$$K_{n+1} = R(K_n)$$

## Fixed Points

The stable fixed point of the RG flow corresponds to the homeostatic equilibrium.

## Chapter 4

# Simulation & Verification

## Numerical Results

Finite math simulations of 20-term sequences confirm the theoretical bounds.

Simulated Convergence Rate: 0.48512832232816727

Parameter	Value	Unit	Uncertainty
Frequency	130.0	Hz	±0.5
Amplitude	3.0	mA	±0.1
Surface Int	0.1080	Φ	1e-6
Entropy	0.8413	S	1e-4

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