Discussion: Nibbler's Primordial Operations

Conceptualization based on P. Pignatelli's R&D

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Abstract

This document outlines a conceptualization of the Nibbler algorithm's primordial operations, functioning as a foundational machine for pattern discovery and abstraction within the Fundamental Interaction Language (FIL) framework. It builds upon the idea of elemental tokens (T_1 for presence/distinction, T_0 for absence/background) emerging from an initial Information Substrate via an Observation process, forming the "tape" for the Nibbler.

1 Introduction

The goal is to define the Nibbler's first cycle of operation, transforming Level 0 patterns ($P_0 = \{T_1, T_0\}$) into Level 1 composite patterns (P_1). This exploration is grounded in the "Information-Observation-Language Triad" and the principles of Semantic Physics outlined in related research.

2 Assumptions for Primordial Nibbler (Level 0 $\rightarrow$ Level 1 Abstraction)

1. **FL Field as Substrate (I):** The universe exists as an FL Field, an undifferentiated information substrate (pure potential, "Chaos=Energy").
2. **First Distinction/Observation (O):** An event occurs (e.g., symmetry breaking, localized stable energy fluctuation) that makes a distinction possible. This observation operator O acts on I to produce a localized state $K_{observed}$ describable in terms of T_1 and T_0.
3. **"Tape" of Elemental Tokens:** The output of O acting on I is conceptualized as a sequence or localized configuration of T_1s and T_0s. This is the "tape" the primordial Nibbler reads.
4. **Fundamental Constants Relevant:**
   - $\hbar_{lang}$: Minimal semantic action/energy cost for instantiating/distinguishing T_1 from T_0.
   - τ_0: Minimal time unit for observation/processing.
   - c_{obs}: Observation realization bound, limiting formation speed of $K_{observed}$.

3 Nibbler's Primordial Cycle: Level 0 Operations (Building P_1 from P_0)

Let $P_0 = \{T_1, T_0\}$ be the set of elemental patterns/symbols. The goal of this cycle is for the Meta-Pattern Extractor M_0 to produce P_1, the first set of composite patterns.

3.1 O_0 (Primordial Observation Set)

- **Definition:** O_0 consists of elementary configurations or short sequences of P_0 tokens that the Nibbler "reads" from the FL Field via the observation operator O.
- **Segmentation by O into $o \in O_0$:**
  - *Windowing (Assumed):* Sliding window of minimal length L_{min} (e.g., 1, 2, or 3 τ_0-scaled units). Each window content $o_k = (t_1, t_2, \ldots, t_L)$ where $t_j \in P_0$.
    - Example $L_{min} = 1$: $O_0 = \{\langle T_1 \rangle, \langle T_0 \rangle\}$.
    - Example $L_{min} = 2$: $O_0 = \{\langle T_1 T_1 \rangle, \langle T_1 T_0 \rangle, \langle T_0 T_1 \rangle, \langle T_0 T_0 \rangle\}$.
  - *Event-Driven (Alternative):* Observations like "a T_1 appeared at locus x, time T".
- **Current Assumption:** Small, fixed-length windows for initial O_0.

3.2 P_s (Primordial Proof Validation Set - $P_{0,rules}$)

- **Definition:** Rules or conditions determining if an observed $o \in O_0$ is "valid" or "meaningful" for pattern formation.
- **Initial $P_{0,rules}$ (Simplistic):**
  1. *Existence/Observability:* Any o successfully observed via O from I.
  2. *Stability/Recurrence (implies memory):* o observed repeatedly or persists.
  3. *Energy Signature (connects to $\hbar_{lang}$):*
     - Energy cost: $E(T_1) = \hbar_{lang}$, $E(T_0) = 0$.
     - Sequence energy: $E(o) = \sum E(t_j)$.
     - $P_{0,rules}$ might favor o with $E(o) > 0$ (contains at least one T_1).
- **Current Assumption:** $P_{0,rules}$ involve existence and simple stability/recurrence.

3.3 V_s (Primordial Verification Operator - V_0)

- **Definition:** $V_0(o)$ applies rules from $P_{0,rules}$ to $o \in O_0$.
- **Operation:** $V_0(o)$ = TRUE if o was observed AND (optionally) meets minimal stability/recurrence AND (optionally) $E(o)$ is non-trivial.

3.4 R_0 (Primordial Recognition Operator)

- **Input:** The set of all observations O_0.
- **Output:** Subset $O_{0,recognized} \subset O_0$, containing "pattern-like" observations.
- **Mechanism (Kernel-Based, Def 8.6 from main9.pdf):** $k_N(x, y) = \alpha k_D(x, y) + (1 - \alpha) k_P(x, y)$. o_k is recognized if $k_N(o_k, \text{candidate}) \geq \theta$.
  - *Primordial $k_P(o_k, baseline)$ (Pattern Kernel):* Similarity of o_k to a "non-pattern" baseline. Measures internal order, repetition, symmetry within o_k (e.g., low internal entropy).
  - *Primordial $k_D(o_k, context)$ (Discovery Kernel):* How much o_k "stands out" from its spatio-temporal context.
  - α: Balances k_P and k_D.
  - θ: Recognition threshold.
- **Alternative for R_0:** If V_0 includes stability, then $O_{0,recognized} = \{o \in O_0 | V_0(o) = \text{TRUE}\}$.

3.5 M_0 (Primordial Meta-Pattern Extractor)

- **Input:** $O_{0,recognized}$.
- **Output:** P_1 (first set of composite patterns/symbols).
- **Mechanism (Abstraction/Symbolization):**
  1. *Grouping/Clustering (Implicit):* Identify identical or highly similar sequences in $O_{0,recognized}$.
  2. *Abstraction/Symbolization (Naming):* If a sequence $p_a = \langle T_1 T_0 T_1 \rangle$ from $O_{0,recognized}$ is sufficiently stable/recurrent (threshold η_{M0}), M_0 assigns it a new symbol S_A. Then $S_A \in P_1$.
  3. *Properties of $S_A \in P_1$:*
     - Constituents: Defined by its P_0 token composition.
     - Energy/Complexity (E_{entity} for S_A): Sum of P_0 constituent energies + compositional cost.
     - Informational Area (A_{entity} for S_A): Related to its length/footprint.
- **Examples of P_1 patterns:** S_{double_T1} (for $\langle T_1 T_1 \rangle$), $S_{alternating\_pair}$ (for $\langle T_1 T_0 \rangle$), $S_{boundary\_left}$ (for $\langle T_0 T_1 \rangle$), $S_{boundary\_right}$ (for $\langle T_1 T_0 \rangle$).

3.6 The Cycle Repeats: Building P_2 from P_1

- Symbols in P_1 (e.g., $S_A, S_B, \dots$) become the alphabet for Level 1.
- O_1 will be sequences of these P_1 symbols (e.g., $\langle S_A S_B S_A \rangle$).
- V_1, R_1, M_1 operate on these P_1-based sequences to create P_2, and so on, building the fractal hierarchy.

4 Critical Questions for This Primordial Nibbler

1. **Nature of O (Observation Operator $I \to K$):** How is undifferentiated I segmented into a "tape" of T_1/T_0 that O_0 samples? Are T_1, T_0 the first "nodes in a graph" produced by O?
2. **Definition of Primordial Kernels (k_P, k_D):** What are plausible mathematical forms for these kernels operating on T_1/T_0 sequences?
3. **Mechanism of M_0 (Abstraction/Symbolization):** How does M_0 decide which recognized sequences become new symbols in P_1? (Role of threshold η_{M0}).
4. **Role of "Energy" and "Bounds" at Each Step:**
   - Do R_0, M_0 operations have an energy cost ($\hbar_{lang}$ based)?
   - Are patterns in P_1 (and P_i) constrained by Bekenstein-like bounds ($I_{FIL}(pattern) \leq \alpha A_{pattern} E_{pattern}$)?