FIL Reference Sheet (Partial Draft)

Version: Step 1 – Partial, covering Opus_4 Ch. 1–4 and Cardinality Cascade (3.2.5)

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1 Chapter 1 – Foundations

1.1 Definition 1.1 – FL Field

The FL Field is defined as a mapping:

$$\mathcal{F}_L : \mathcal{O} \times \mathcal{I} \to \mathcal{L}$$

where:

- $\mathcal{O}$: Observer states
- $\mathcal{I}$: Information states
- $\mathcal{L}$: Laws inferred from the interaction of observer and information

1.2 Theorem 1.1 – Observer–Law Duality

Given an observer state o and an information state i, there exists a unique law l in $\mathcal{L}$ such that $\mathcal{F}_L(o, i) = l$. Conversely, for any l there exists at least one (o, i) pair producing it.

Proof Sketch: Follows from surjectivity of $\mathcal{F}_L$ on $\mathcal{L}$ and injectivity on $\mathcal{O} \times \mathcal{I}$ under fixed l.

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2 Chapter 2 – Computational Bounds

2.1 Definition 2.1 – Computational Light-Speed

From Landauer and Bremermann bounds:

$$c_{\text{comp}}(T) = \frac{2k_B T \ln 2}{\pi\hbar}$$

2.2 Theorem 2.1 – Maximum Processing Rate

Any physical system at temperature T cannot exceed $c_{\text{comp}}(T)$ logical operations per second.

Proof: Combine Landauer's minimum energy per bit $E_L = k_B T \ln 2$ with Bremermann's maximum rate $R_{\max} = 2E/(\pi\hbar)$.

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3 Chapter 3 – Semantic Structures

3.1 Definition 3.1 – Semantic Temperature

A scalar field over semantic space indicating the effective processing temperature for a domain.

3.2 Definition 3.2 – Semantic Distance

$$d_{\text{sem}}(L_1, L_2) = \sqrt{[H(L_1|L_2) + H(L_2|L_1)]^2 + (\Delta S_{\text{struct}})^2}$$

3.3 Theorem 3.2 – Optimal Bridging Temperature

$$T_{\mathrm{opt}}(L_1, L_2) = \frac{\pi\hbar}{2k_B \ln 2}\, d_{\mathrm{sem}}(L_1, L_2)\, f(\Phi_1, \Phi_2)$$

Proof: Derived from principle of least computational action, balancing activation energy with Boltzmann factor.

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4 Section 3.2.5 – Cardinality Cascade

4.1 Theorem 3.11 – Computational Generation Bound

$$\frac{d|\Lambda(\ell)|}{dt} \leq c_{\mathrm{comp}}(T)$$

Interpretation: The universe cannot generate distinguishable semantic objects faster than $c_{\mathrm{comp}}(T)$.

4.2 Definition 3.10 – Semantic Cardinality Levels

- Level 0: $|P_0| = 2$ (primordial states)
- Level n: $|P_n| \leq e^{S_{\max,n}/k_B}$

4.3 Theorem 3.12 – Entropy–Cardinality Correspondence

$$|\Lambda(\ell_n)| \leq \exp\left(\frac{1}{k_B}\int_0^t c_{\mathrm{comp}}(T(\tau))\, d\tau\right)$$

Proof: Each object generation dissipates $k_B T \ln 2$ entropy. Integrating available processing over time gives the bound.

4.4 Theorem 3.16 – Physical Incompleteness

Any finite computational system with total available operations $\int_0^t c_{\mathrm{comp}}(T)d\tau$ cannot generate all semantically valid self-referential statements.

Proof: Diagonal argument applied under finite operation count constraint.

End of Partial Draft