The Equation of Existence: A Fourth-Layer Law of Persistence

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Abstract

We introduce a concise law for when patterns continue to exist through time. The *Equation of Existence* unifies two regimes: (i) persistence by equilibrium feedback (stability) and (ii) persistence by feedback-driven learning with memory (adaptivity). This fourth-person perspective highlights the conditions under which biological, social, and artificial systems endure or collapse.

1 Introduction

Why do some patterns exist through time, while others dissolve? Existence—that is, persistence across time—is not given; it is *achieved* by systems that either (a) resist perturbation via restoring dynamics (stability) or (b) adapt via feedback, learning, and memory (adaptivity). We give a compact formalization that captures both.

2 Equation of Existence

Let $X(t)$ denote the system's pattern or state, embedded in an environment $E(t)$ and supported (optionally) by a memory substrate M. Existence is the maintenance of X within a viability region $\mathcal{V}$.

$$\boxed{\frac{dX}{dt} \;=\; R(X,E) \;+\; A(X,E;M)} \tag{1}$$

where:

- $R(X,E)$ is **restoring (equilibrium) feedback**: dynamics that counter perturbations without learning,
- $A(X,E;M)$ is **adaptive feedback**: learning L whose changes are retained in memory M.

Discrete agent form.

$$X_{t+1} = G(X_t, E_t) \;+\; L_t(E_t; M_t)\,, \tag{2}$$
$$M_{t+1} = U(M_t, X_t, E_t)\,. \tag{3}$$

Persistence criteria. We say X persists if either $X_t \in \mathcal{V}$ for all t, or if a viability functional P satisfies

$$P(X_{t+1}) - P(X_t) \;\geq\; 0. \tag{4}$$

Two unified regimes.

- **Stability:** $A \equiv 0$ and R has an attracting fixed point inside $\mathcal{V}$ (no further learning is required).
- **Adaptivity:** $A \not\equiv 0$; feedback updates, stored in M, track moving targets while keeping X inside $\mathcal{V}$.

3 The Ladder of Persistence

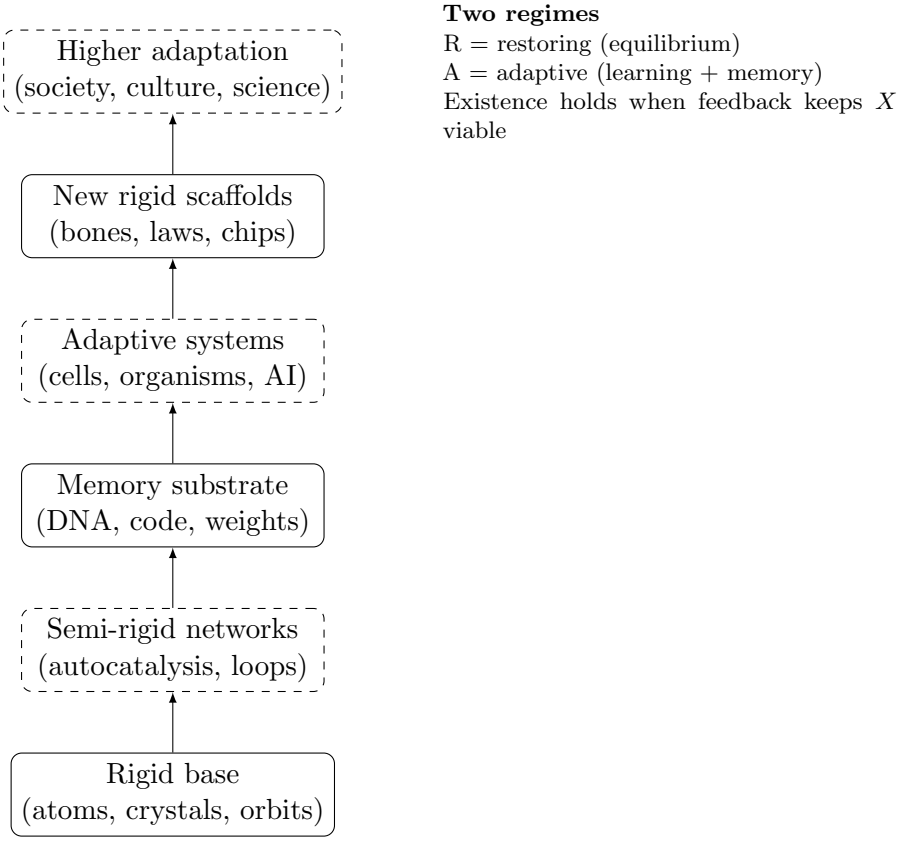

Figure 1: Alternation of rigid scaffolds (solid) and adaptive layers (dashed). Existence persists when equilibrium feedback (R) and/or adaptive feedback with memory (A) keep the system within its viability region.

4 Discussion

Equation (1) treats existence as a maintained flow. A pattern endures if either (i) it sits in a self-restoring equilibrium (the R term suffices), or (ii) it learns, stores, and deploys updates that keep it viable (the A term). In practice, systems intertwine both regimes across time scales: fast signals, medium learning, slow memory.

References (minimal)

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