Structured Dynamics in The Algorithmic Agent

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In the Kolmogorov Theory of Consciousness, algorithmic agents utilize inferred compressive models to track coarse-grained data produced by simplified world models, capturing regularities that structure subjective experience and guide action planning. Here, we study the dynamical aspects of this framework by examining how the requirement of tracking natural data drives the structural and dynamical properties of the agent.

We first formalize the notion of generative model using the language of symmetry from group theory, specifically employing Lie pseudogroups to describe the continuous transformations that characterize invariance in natural data. Then, adopting a generic neural network as a proxy for the agent dynamical system and drawing parallels to Noether's theorem in physics, we demonstrate that data tracking forces the agent to mirror the symmetry properties of the generative world model. This dual constraint on the agent's constitutive parameters and dynamical repertoire enforces a hierarchical organization consistent with the manifold hypothesis in the neural network.

Our findings bridge perspectives from algorithmic information theory (Kolmogorov complexity, compressive modeling), symmetry (group theory), and dynamics (conservation laws, reduced manifolds), offering insights into the neural correlates of agenthood and structured experience in natural systems, as well as the design of artificial intelligence and computational models of the brain.