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Demon Dynamics: Deterministic Chaos, the Szilard Map, and the Intelligence of Thermodynamic Systems[1] ALEXANDER BOYD, JAMES CRUTCHFIELD, UC Davis — We introduce a deterministic chaotic systemthe Szilard Mapthat encapsulates the measurement, control, and erasure protocol by which Maxwellian Demons extract work from a heat reservoir. Implementing the Demons control function in a dynamical embodiment, our construction symmetrizes Demon and thermodynamic system, allowing one to explore their functionality and recover the fundamental trade-off between the thermodynamic costs of dissipation due to measurement and due to erasure. The maps degree of chaoscaptured by the Kolmogorov-Sinai entropyis the rate of energy extraction from the heat bath during control. Moreover, an engines statistical complexity quantifies the minimum necessary system memory for it to function. In this way, dynamical instability in the control protocol plays an essential and constructive role in intelligent thermodynamic systems.

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