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From quantum resource theories to discrete dynamical systems

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Resource theories have been widely used in quantum information as a framework for quantifying quantum resources, even of remarkably different types. However, the applicability of such a framework is far more general than quantum theory, given that its mathematical underpinning lies in category theory, which is a universal paradigm in math. In this way, resource theories can be extended beyond their traditional domain to study new phenomena arising in non-quantum scenarios. Here, for the first time, we apply resource theories to finite discrete dynamical systems. In particular, we use them to develop a rigorous theory of external influences, going beyond the perturbation paradigm, in that the external influence need not be a small contribution. The core of our work is the notion covariance influence: if we evolve a dynamical system for n time steps and then we disturb it, it is the same as first disturbing the system with the same influence and then letting the system evolve for n time steps. Using resource theories, we provide necessary and sufficient conditions for the transition between states under deterministic covariant influences and necessary conditions in the presence of stochastic covariant influences, predicting which transitions between states are forbidden.

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