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Dependence of dissipation on the initial distribution over states
ARTEMY KOLCHINSKY, DAVID H. WOLPERT, Santa Fe Institute — We consider a driven nonequilibrium system. There is a large literature on how the amount of work dissipated during such driving varies with changes to the driving process, for a fixed initial distribution over microstates. We instead analyze how the amount of work dissipated for a fixed driving process varies with changes to the initial distribution over microstates. We show that the dissipated work for a given initial distribution has a simple information-theoretic form that depends only on the initial and final distributions, and reflects the logical irreversibility of the process. Our results hold under very general conditions, independent of how long the process takes, whether it obeys local detailed balance, etc. We also consider the case where the process induces dynamics over a space of coarse-grained macrostates that implement some specified computation (i.e., a specified map from initial "input" macrostates to ending "output" macrostates). We show that our formulas for extra dissipated work still hold, only now stated in terms of distributions over the macrostates of the computer, and that this extra dissipated work reflects changes to the distribution of a computer's inputs. It is a novel thermodynamic cost of computation, in addition to the well-known Landauer's cost.

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