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A statistical–mechanical view on source coding: physical compression and data compression

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Abstract. We draw a certain analogy between the classical information–theoretic problem of lossy data compression (source coding) of memoryless information sources and the statistical mechanical behavior of a certain model of a chain of connected particles (e.g., a polymer) that is subjected to a contracting force. The free energy difference pertaining to such a contraction turns out to be proportional to the rate–distortion function in the analogous data compression model, and the contracting force is proportional to the derivative this function. Beyond the fact that this analogy may be interesting on its own right, it may provide a physical perspective on the behavior of optimum schemes for lossy data compression (and perhaps also, an information–theoretic perspective on certain physical system models). Moreover, it triggers the derivation of lossy compression performance for systems with memory, using analysis tools and insights from statistical mechanics.