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Beating Landauer's Bound: Tradeoff between Accuracy and Heat Dissipation SAURAV TALUKDAR, SHREYAS BHABAN, MURTI SALAPAKA, University of Minnesota — The Landauer's Principle states that erasing of one bit of stored information is necessarily accompanied by heat dissipation of at least $k_bT\ln 2$per bit. However, this is true only if the erasure process is always successful. We demonstrate that if the erasure process has a success probability$p$, the minimum heat dissipation per bit is given by $k_bT\left(p\ln p+(1-p)\ln(1-p)+\ln 2\right)$, referred to as the Generalized Landauer Bound, which is $k_bT\ln 2$if the erasure process is always successful and decreases to zero as p reduces to 0.5. We present a model for a one-bit memory based on a Brownian particle in a double well potential motivated from optical tweezers and achieve erasure by manipulation of the optical fields. The method uniquely provides with a handle on the success proportion of the erasure. The thermodynamics framework for Langevin dynamics developed by Sekimoto is used for computation of heat dissipation in each realization of the erasure process. Using extensive Monte Carlo simulations, we demonstrate that the Landauer Bound of $k_bT\ln 2$is violated by compromising on the success of the erasure process, while validating the existence of the Generalized Landauer Bound.

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