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On the status of Landauer's principle[1]

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Maxwell's demon is a creature who cunningly violates the second law of thermodynamics. In what sense is such a demon possible? Whilst thermodynamics legislates against such a creature, the demon looks eminently possible according to the underlying classical or quantum dynamics: Poincare's recurrence theorem and Loschmidt's reversibility objection reveal that entropy can decrease in certain situations. The orthodoxy is that Maxwell's demon is vanquished by Landauer's principle, according to which there is an entropy cost to reset the demon's memory - a vital step in the cyclic process that supposedly leads to a violation of the second law. But the status of Landauer's principle is controversial: some take it as obviously true, others (such as John Norton) have criticised the proofs of this principle. In this talk, I clarify the status of Landauer's principle. First I discuss which assumptions are required to establish Landauer's principle, and argue that establishing to which theory (thermodynamics, statistical mechanics or quantum mechanics) these principles belong reveals the status of Landauer's principle. I then consider one of Norton's counterexamples to Landauer's principle, and discuss how it depends on certain views about the physical implementation of computation.

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