Non-equilibrium statistical mechanics of Noisy Computing

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Properties of computing Boolean circuits composed of noisy logical gates are studied using the non-equilibrium statistical mechanics methodology. A formula growth process that gives rise to random Boolean functions is mapped onto a spin system, which facilitates the study of their typical behavior in the presence of noise. Bounds on their performance, derived in the information theory literature for specific gates, are straightforwardly retrieved, generalized and identified as the corresponding macroscopic phase transitions. The framework is employed for deriving results on error-rates at various function-depths and function sensitivity, and their dependence on the gate-type and noise model used.

References

[1] A. Mozeika, D. Saad and J. Raymond, Phys. Rev. Lett. **103**, 248701 (2009).