Statistical Mechanics and Error-correcting Codes

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I will first show that there is a mathematical correspondance between error-correcting codes and certain mathematical models of disordered spin systems.

I will then show how the recently discovered (or rediscovered) codes which approach Shannon's Chanel Capacity (turbo codes and low density parity check codes) can be analysed using statistical mechanics. It is possible to show, using statistical mechanics, that these codes allow error-free communication for signal to noise ratio above a certain threshold. This threshold, which corresponds to a phase transition in the spin model, depends on the particular code, and can be computed analytically in many cases.

Finally I will discuss some recent progress and some open problems.