## SPIN GLASSES IN OPTIMIZATION THEORY AND BIOLOGY

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Besides being useful models of random magnetic systems, spin glasses are central to recently developed connections between statistical mechanics and important problems in multivariate optimization. Finding near-optimal solutions to hard (NP-Complete) optimization problems is precisely analogous to determining low temperature properties of spin glasses. A way to accomplish this is careful annealing, which may be simulated on a computer by Monte Carlo techniques. This analogy is developed in more detail in an article, to appear in Science, by S. Kirkpatrick, C. D. Gelatt, Jr., and M. P. Vecchi. Applications to partitioning, placement, and wire routing problems which occur in the computeraided design of computers are described in that article, as well as a Monte Carlo treatment of the classic NP-Complete "travelling salesman" problem. A paper by Vecchi and myself which gives more extended analysis of wiring has been submitted for publication.

The combination of diversity and stability which the low temperature phase of a spin glass provides has also caused several authors to suggest biological settings for spin glass behavior. J. J. Hopfield and P. W. Anderson, in papers currently circulating as preprints, propose models for associative memory and the chemical evolution of genetic polymers such as DNA, respectively, which are based upon spin glass Hamiltonians. FROM THE SUMMARY TALK (2)



This can produce weakly glassy state.