

Combinatorial algorithms and statistical physics

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Abstract: A large fraction of the models used in statistical physics are combinatorial, such as the famous Ising and Potts models. The ground states of models such as these map to the global minima of combinatorial optimization problems, while their partition functions map to counting problems. Key impacts that combinatorial algorithms have made in statistical physics, and its applications to material science and molecular biology, will be surveyed. Recent progress in understanding the nature of hard instances in NP-complete decision problems through the use of statistical physics ideas will be outlined, and new heuristics based these ideas will be elucidated. The importance of the percolating core of a graph for computational complexity will be discussed, and illustrated by experimental results for hard instances of NP-complete problems such as maximum independent set on a variety of graphs.