Qeios

Peer Review

Review of: "An Approximated QUBO Formulation for Solving Practical SAT Problems"

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1. Summary of the Paper

This paper proposes an approximate method to formulate 3SAT problems as QUBO problems. The suggested formulation does not require additional variables compared to exact methods, where they add m variables if m is the number of clauses. Using a simulated annealing solver, the author compares different formulations (both exact and approximate) on "practical" problems, evaluating them based on the number of unsatisfied clauses in the solutions and the total running time. The proposed method outperforms other formulations in nearly all tested examples.

The method works by applying MAX2SAT formalization to binary clauses and NAE3SAT formalization to ternary clauses for each instance of a 3SAT problem. The method's success appears to be closely tied to the high percentage of binary clauses in "practical" SAT problems.

2. Strengths

Well-Described Methodology: The paper clearly explains the proposed formulation and includes explicit details about the hyperparameters chosen for the Simulated Annealing Sampler (SAS) used to solve the QUBO problems.

3. Suggestions for Improvement

Add Details of the Problem Formulations: The original formulation of each "practical" problem (e.g., PHP, GC, etc.) should be described in greater detail. This would help readers better understand the specific challenges addressed by the proposed method.

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Theoretical Explanation for PHP Results: The proposed formulation appears to solve PHP instances exactly. The paper would benefit from a deeper theoretical explanation for this observation.

Clarify Focus on 3SAT: It should be explicitly stated at the beginning that the formulation is specifically applied to 3SAT instances, as this focus is central to the method.

4. Conclusion

The results are interesting and demonstrate the potential of the proposed approach. However, the findings feel somewhat light for publication in their current form. As a non-expert in Ising solvers, I may not fully appreciate the broader significance of the results. Expanding the theoretical insights and adding more detailed explanations for the specific results observed could significantly strengthen the paper's impact.

Declarations

Potential competing interests: No potential competing interests to declare.