Polynomial 3-SAT Encoding for K-Colorability of Graph

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Abstract
Graph k-Colorability (for k ≥ 3) Problem (GCP) is an well known NP-Complete problem; till now there are not any known deterministic methods that can solve a GCP in a polynomial time. To solve this efficiently, we go through Propositional Satisfiability, which is the first known NP-Complete problem [3]. However, to use the SAT solvers, there is a need to convert or encode an k-colorable graph to 3-SAT first. In this paper, we are presenting a polynomial 3-SAT encoding technique for k-colorability of graph. Alexander Tsiatas [1] gave a reduction approach from 3-Colorable graph to 3-SAT encoding. According to [1], total number of clauses generated in 3-CNF-SAT formula for 3-colorable graph G = (V, E) is $(27*|V|) + (256*|E|))$. In our earlier
formulation of reduction of k-colorable graph to 3-SAT [2], we generalized [1] for k-colorable graph and generated \(((kk^*(k-2)*|V|) + (22k+2 *|E|))\) clauses in 3-CNF. Here, we present our approach to encode a k-colorable graph to 3-CNF-Satisfiability (SAT) formula in polynomial time with mathematical proof. Our formulation generates total \(((k-2)*|V| + (k*|E|)\) clauses in 3-CNF for k-colorable graph. Thus, our formulation is better than approach [1] and [2]. Also, we tested our encoding formulation approach on different graph coloring instances of DIMACS[8][9].

Reference


Index Terms

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graph coloring
NP-Complete
k-colorable
chromatic number
DIMACS

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