A Generalized Bounded Graph Coloring Problem

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Abstract

The generalized graph coloring problem is defined on edge-weighted graphs. Unlike the classical graph coloring problems, in a generalized graph coloring problem, adjacent vertices can receive same colors, and purpose is assigning K colors to all vertices of a graph, so that the total weight of edges connecting vertices with the same color is minimized. Here, we formulate and solve a new generalized graph coloring problem. The problem asks to satisfy an additional constraint: the total capacity of colors is bounded, i.e. the sum of the weights of the vertices assigned to the same color cannot exceed a given capacity. Each color c_k, $(k = 1,2, \dots, K)$, is used at most u_k times. This problem can be interpreted as a *Bin Packing Problem with Conflicts*, in which we are given n items i with weight w_i and a number of K identical bins, each bin c_k, $(k = 1,2, \dots, K)$ has a finite capacity u_k. The aim of the problem is to assign all items in the bins, while ensuring that the total weight of all items assigned to a bin does not exceed the weight capacity and that the total conflicting degree of items (as the total weight of edges) is minimized. A binary programming problem is utilized to formulate the problem, and for solving the problem a hybrid local search genetic algorithm will be presented. Practical uses of the proposed algorithm are illustrated with some different-size problems.

Keywords: Weighted graph; Generalized graph coloring; Bin packing problem; conflict items; Binary programming; Genetic algorithm.