Chapter 3

Hybrid Genetic Approach for Solving Fuzzy Graph Coloring Problem

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ABSTRACT

A hybrid genetic approach (HGA) is proposed to solve the fuzzy graph coloring problem. The proposed approach integrates a number of new features, such as an adapted greedy sequential algorithm, which is integrated in genetic algorithm to increase the quality of chromosomes and improve the rate of convergence toward the chromatic number. Moreover, an upper bound is used to generate the initial population in order to reduce the search space. Experiments on a set of five well-known DIMACS benchmark instances show that the proposed approach achieves competitive results and succeeds in finding the global optimal solution rapidly for complex fuzzy graph.

INTRODUCTION AND BACKGROUND

The Graph coloring is highly studied as a combinatorial optimization problem (Pardalos, 1998). Several practical problem can be modeled by graph coloring such as traffic light signal, frequency assignment problem (Roberts, 1979), register allocation (Chaitin, 1981), etc. It includes both vertex coloring and edge coloring. However, the term graph coloring usually refers to vertex coloring rather than edge coloring (Jensen, 2011).

The objective of the graph coloring problem (GCP) is to find minimum number of vertices clusters with respect to the adjacency constraint in such a way that two connected vertices cannot be in the same cluster, each cluster use a color to mark his vertices.

A graph is called a k-colored graph, if accept a k-coloring, and k is called the chromatic number $\chi$ when it is the minimum possible color for coloring the graph.

The chromatic number is given by the following formula:

$$\chi(G) = \min \left( k : P(G,k) > 0 \right)$$

The graph coloring problems are very interesting from the theoretical standpoint since they are a class of NP-complete problems that also belong to constraint satisfaction problems (Garey, 2002).

The coloring problem in the real world applications are not always made of sure relation between items so connection between vertices should not be defined in connected or not connected but can be presented in a certain degree of connection.

The fuzzy graph coloring problem (FGC) is an extension of the GCP introduced for the first time by Kaufmann (Kaufmann, 1976), while Rosenfeld (Rosenfeld,
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