Research Article

A Binary Cat Swarm Optimization Algorithm for the Non-Unicost Set Covering Problem

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The Set Covering Problem consists in finding a subset of columns in a zero-one matrix such that they cover all the rows of the matrix at a minimum cost. To solve the Set Covering Problem we use a metaheuristic called Binary Cat Swarm Optimization. This metaheuristic is a recent swarm metaheuristic technique based on the cat behavior. Domestic cats show the ability to hunt and are curious about moving objects. Based on this, the cats have two modes of behavior: seeking mode and tracing mode. We are the first ones to use this metaheuristic to solve this problem; our algorithm solves a set of 65 Set Covering Problem instances from OR-Library.

1. Introduction

The Set Covering Problem (SCP) is a classic problem that consists in finding a set of solutions which allow to cover a set of needs at the lowest cost possible. There are many applications of these kinds of problems; the main ones are location of services, files selection in a data bank, simplification of boolean expressions, and balancing production lines, among others.

In the field of optimization, many algorithms have been developed to solve the SCP. Examples of these optimization algorithms include Genetic Algorithm (GA), Ant Colony Optimization (ACO), and Particle Swarm Optimization (PSO). In this work we use a Cat Swarm Optimization (CSO) algorithm to solve the SCP.

By simulating the behavior of cats, CSO can solve optimization problems. It has been analysed that cats spend most of their time resting when they are awake. While they rest, they move from their position carefully and slowly. This behavioral mode is the one called seeking mode. In the tracing mode, a cat moves according to its own speed for all dimensions. This search method will be discussed in detail later in this paper.

The CSO was originally developed for continuous valued spaces. But there exist a number of optimization problems, as the SCP, in which the values are not continuous numbers but rather discrete binary integers. Sharafi et al. introduced a discrete binary version of CSO for discrete optimization problems: Binary Cat Swarm Optimization (BCSO). BCSO is based on CSO algorithm proposed by Chu et al.