Performance evolution of Bee Colony Optimization for Fuzzy Clustering

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Abstract
Bee Colony Optimization algorithm is a population based swarm intelligent family, it has to solve local optima problem and which is inspired by the principles of natural biological behaviour and circulated communal behaviour of social colonies has shown superiority in production with complex optimization problems. In this paper, have to studied Fuzzy Bee Colony Optimization (FBCO) was wished-for that algorithm furnished incredibly shining effect.

1. Introduction

A Cluster analysis is based on a mathematical formulation of the determinant of relationship. Clustering methods are convenient in many difference areas [2] such as pattern recognition and machine learning, etc. In some cases, however, cluster analysis is only a useful starting point for other purposes, such as data summarization.

Clustering can be considered the most significant unsupervised learning technique. So, as every extra problem of this kind, it deals with judgment a structure in a collection of unlabeled information.

Fuzzy theory introduced by Lotfi Zadeh, the researchers put the fuzzy theory into clustering. Fuzzy algorithms can assign data object partially to [6] multiple clusters. The degree of membership in the fuzzy clusters depends on the closeness of the data object to the cluster centers.

The most popular fuzzy clustering algorithm is fuzzy c-means (FCM) which introduced by Bezdek (1974) and now it is widely used. Fuzzy c-means [2] clustering is an effective [7] algorithm, but the random selection in center points makes iterative process falling into the local optimal solution easily. For solving this problem, recently, evolutionary algorithms such as genetic algorithm (GA), simulated annealing (SA), ant colony optimization (ACO), and particle swarm optimization (PSO) have been successfully applied.

Bee Colony Optimization (BCO) algorithm, which is described [1] by Karaboga based on the foraging behavior of honey bees for numerical optimization problems, is applied to classification benchmark [3] problems. In this paper, we introduced a bee colony optimization for TSP called Fuzzy Bee Colony Optimization (FBCO).

2. Bee Colony Optimization

Swarm Intelligence (SI) is defined as the collective problem-solving capabilities of social animal’s. SI is the direct result of self-organization in which the interactions of lower-level components create a global-level dynamic structure that may be regarded as intelligent.

A bee-inspired algorithm mimics the foraging behavior of the honey bees. These algorithms [3] use standard evolutionary or random explorative search to locate promising locations. Then the algorithms utilize the exploitative search of the most promising locations to find the global optimum.

It is an emerging field for researchers in the field of optimization problems because it provides immense problem solving scope for combinatorial and NP hard problems. BCO is one of the benchmark systems, portraying team work, collaborative work. The idea behind the BCO is to create the multi agent system (colony of artificial bees) capabilities to successfully solve difficult combinatorial Optimization problems.

Swarm Intelligent is a bottom-up type of problem solving technique and it has many real time applications like Robotics, Artificial Intelligence, process optimization, staff scheduling, telecommunications, entertainment, routing, software engineering, software testing, networking etc.

The bee colony optimization, meta-heuristic belongs to the class of nature inspired algorithms. This technique uses an analogy between the way in which bees in nature search for a food, and the way in which [4] optimization search for an optimum in combinatorial optimization problems. Artificial bees represent agents, which collaboratively solve complex combinatorial optimization problem.

Bee colony optimization is an [5] inspired from the bright foraging performance of honey bee swarms and...
it is swarm intelligence. Its strength is its robustness and its simplicity. It is finding a food source called nectar is called as the fitness and sharing information of food source among bees and

This is investigation of the manners of bees. There are three types of bees are working with that algorithm, such as

2.1. Employee Bee

The employed bee stays on a food source and in its memory provides the neighborhood of the food source. Each employed bee carries with her information about the food source and shares the information to onlooker bee.

2.2. Onlooker Bee

The onlooker bees wait in the hive on the dance area, after getting the information from employed bees about the possible food [1] source then make decision to choose a food source in order to use it.

The onlooker bees select the food source according to the probability of that food source. The food source with lower quantity of nectar that attracts less onlooker bees compared to ones with a higher quantity of nectar.

2.3. Scout Bee

Scout bees are searching randomly for a new solution. The employed bee whose food source has been abandoned it becomes a scout bee.

2.4. Algorithm for FBCO

Step 1 Initialization Phase
- Initialize the cluster number c, the real number m, the size of the population of N,
- Generate initial population zi,
- Calculate the membership matrix by randomly
- Evaluate the population
- Set cycle to 1

Step 2 Repeat
Step 3 for Employed Bee
- Produce new solution ui
  - Calculate the membership matrix
  - Calculate the fitness
  - Apply the greedy selection process
  - Calculate the probability values pi for the solutions

Step 4 For Onlooker Bee and Scout Bee
- Choose a solution zi depending on pi
- Produce new solution ui
  - Calculate the membership matrix
  - Calculate the fitness using
  - Apply the greedy selection process

If there is abandoned solution then replace that solution with a new randomly produced
- solution for the scout
- Assign cycle to cycle + 1
- Memorize the best solution (best cluster centers) achieved yet

Step 5.Until cycle reach converges

The Bee colony optimizations exertions in a self-organized and decentralized way and therefore correspond to a high-quality basis for parallelization. It also poses a capability to go on away from becoming attentive in local minima.

3. Experimental Analysis and Discussions

For evaluating the FBCO method is using real well known datasets such as Iris, Glass, and Cancer.
- Iris flower. For each species, 50 samples with four features were collected;
- Glass, which consists of 214 objects and 6 different types of glasses. Each type has 9 features;
- Wisconsin breast cancer data set, which consists of 683 objects and 2 categories characterized by 9 features;

Table 3.1 Objective value of FBCO

<table>
<thead>
<tr>
<th>Methods</th>
<th>FBCO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Best</td>
</tr>
<tr>
<td>Iris(150,3,3)</td>
<td>59.33</td>
</tr>
<tr>
<td>Glass (214, 6, 9)</td>
<td>68.25</td>
</tr>
<tr>
<td>Cancer (683, 2, 9)</td>
<td>2231.10</td>
</tr>
</tbody>
</table>

The experimental results of over 10 independent runs FBCO are summarized and their objective values are described in Table.6.3 based on [2] and their statistical parameter are shows in Table3.1 As shown in below tables, the FBCO obtained superior results and it can escape from local optima.

Table 6.2 gives a picture of objective value and their value of performance analysis Fuzzy Bee Colony
Optimization with different datasets. The wished-for method of bee colony optimization built-in with fuzzy theory called as Fuzzy Bee Colony Optimization furnished better-quality.

4. Conclusions

In this paper, an optimization algorithm inspired by the natural foraging behaviour of honey bees called Bee Colony Optimization is built-in with fuzzy theory. Among them, the Fuzzy Bee Colony Optimization is making available to well-organized conclusion for fuzzy clustering in data mining. This natural procedure of work provides a number of ways for solving the real world problems more powerfully and rapidly with accuracy.

10. References