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Bio Inspired Bees Behavior Approaches for Computer Science Problems

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Abstract— Bio inspired algorithms plays an important role in solving complex and huge problems in computer science. It helps us in finding the optimal desired way to solve extremely dynamic, difficult and robust problems. These algorithm help us to cope with the technological need of a new era. Many researchers did enormous work in this area from the past few decades. However, bees based algorithm on its different behavior is more useful to solve such kind of problems. This paper presents a few, detailed in of some bees behavior algorithm, which was used in order to tackle various challenges faced in different problems. Bees foraging and marriage behavior is applied to solve many problem such as job scheduling, color graph, Association Rule Mining problem, etc. This paper discussed different bees behavior approaches and basic bee algorithm used to solve different computer science problems.

Index Terms— Association Rule Mining, Bio inspired, Bees behavior, Evolutinary Algorithms,Foraging behavior, Swarm Intelligence, Waggle dance.

1 Introduction

THERE are different Bio Inspired Algorithms [1] such as Ant Colony (AC), Firefly (FF), Flower Pollination (FP), Cuckoo Search (CS), and Honey Bee (HB). Bio Inspired Algorithms actually categorized into two types one is Swarm Intelligence based and second is Evolutionary Algorithms based. Swarm intelligence [2] based algorithms are inspired by the behavior of some social living beings, such as ants, termites, birds, and fishes. In recent years, new swarm intelligence algorithms have appeared, inspired by fish schools, gravity and mass interactions , as well as different aspects of the behavior of bees, bacteria, glow-worms, fireflies, cockroaches, bats and cuckoo birds . Despite the swarm inspiration common to these approaches, they have their own particular way to exploit and explore the search space of the problem. In Swarm algorithm our main concentration is on the implementation of these algorithms in order to solve complex computing problems.

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2 Different Bees Behavior

Out of these algorithm honey bees algorithm is based on honey bee behavior. Bee's behavior is work on how bees collect food centrally and how they communicate to each other. Bees having different behavior like foraging behavior, marriage behavior and queen behavior.

2.1 Foraging behavior

Foraging behavior [1], Honey bee travel over long distances and simultaneously in multiple directions in search of food sources. Scout bees begin their search in order to find for promising good food. Scout bees move randomly from one location to another. When scout bee return to the hive and those scout bees which had found a food, deposit their food and a waggle dance is performed on the dance floor by a bee. While extracting the food from the hive bee monitors the food level. The waggle dance is named based on the wagging run (in which the dancers produce a loud buzzing sound by moving their bodies from side to side), which is used by the scout bees to communicate information about the food source to the rest of the colony. The scout bees provide the following information by means of the waggle dance: the quality of the food source, the distance of the source from the hive and the direction of the source [4, 5]. The waggle dance path has a figure of eight shape. Initially the scout bee vibrates its wing

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muscles which produces a loud buzz and runs in a straight line the direction which is related to the vertical on the hive and indicates the direction of food source relative to sun's azimuth in the field[6]. The scout then circles back, alternating a left and a right return path [7]. The speed/duration of the dance indicates the distance to the food source; the frequency of the waggles in the dance and buzzing convey the quality of the source [6]. This information will influence the number of follower bees. This information helps to decide next task. Hence, in this way foraging behavior is helpful to find solution of different computational problem.

2.2 Marriage bees behavior

Marriage bees behavior [8], is used in honey bees optimization. Bees are social insects living in organized colonies. Each honey-bees colony consists of one or several queens, drones, workers and broods. Queens specialize in egg laying, workers in brood care and sometimes egg lying, drones are the males of the colony and broods the children. The reproduction process of real bees can be summarized as follows: during a mating flight, each queen mates with seven to 20 drones. During each mating, sperm reaches the queen spermatheca and accumulates there to form the genetic pool of the colony. Each time a queen lays eggs (broods), it retrieves at random a mixture of sperm from its spermatheca to fertilize an egg. The queen is then improved by the worker (heuristic). A number of mating flight is undertaken. In each mating flight, the queen's speed and energy are randomly initialized. During this flight, and according to its speed, the queen collects sperm of different drones (a complete solution) with a certain probability. In other words, if the drone is successfully mated with the queen, its sperm is added to the queen's spermatica.When the queen's energy reaches a critical threshold or when its spermatheca is full, it returns to the nest and the brood creation process starts. Several broods are generated by crossing over the queen genome with a sperm selected at random in its spermatheca. A sperm is a partial solution which is completed by the queen's genome. The resulting broods are improved by the worker. If the best brood is better than the queen, then it replaces it. The remaining broods are destroyed, and a new nuptial flight starts. This process is repeated until all the nuptial flights are undertaken or a stopping criterion is reached.

3 Related Work

Many algorithms proposed based on different bees behavior for solving different computational problems and combinatorial optimization problems.

In paper [1], they proposed this bees behavior to solve job fault tolerant problem in cloud computing. Also it is used to solve difficult cloud computing problems. These bees perform their operation by different the random search approach. In this paper, they define the Swarm scheduling algorithm used in cloud computing environment in detailed. Also defined different evolutionary scheduling algorithms.

In Paper [9], has proposed Honey Bees Inspired Optimization Method that is the improved version of Bees Algorithm. In this paper, they define terms like honey bee, foraging behavior, waggle dance. In this paper, they explain the natural foraging behavior of honey bees. They used foraging behavior of honey bee to improve bees algorithm. This algorithm based on swarm intelligence, swarm-based optimization, adaptive neighborhood search and site abandonment. The aim of this paper is to describe an optimization algorithm called the Bees Algorithm, inspired from the natural foraging behavior of honey bees, to find the optimal solution. The algorithm performs both an exploitative neighborhood search combined with random explorative search. In this paper, an optimization algorithm inspired by the natural foraging behavior of honey bees, called the Bees Algorithm, has been discussed, and an enhanced version called ANSSA-based Bees Algorithm has been proposed. They proposed ANSSA-based has been successfully applied on continuous type benchmark functions and compared with other well-known optimization techniques.

In Paper [8], has proposed different techniques about how can bees colour graphs. In this paper, they propose MBO approach for the graph colouring problem (GCP). Marriage in honey bees optimisation (MBO) is a recent evolutionary metaheuristic inspired by the bees reproduction process. They highlights term like graph colouring problem, GCP, Metaheuristics, marriage in honey bees optimization ant colony system, Tabu search, TS, hybrid colouring algorithm, HCA, DSATUR and RLF. They proposed new swarm approach MBO to combinatorial optimisation problems inspired by the bee's reproduction process. Contrary to most swarm intelligence algorithms such as ant colony optimisation, MBO uses selforganisation to mix different heuristics. In this paper, we presented an MBO approach for the GCP. In this approach, several queens are generated randomly or by a specific constructive method.

In paper [10], deals with Association Rules Mining algorithms for very large databases and especially for those existing on the web. Different algorithms are not capable to cope with a huge amount of data in the web context where the respond time must be very short. This paper, mainly proposes two new Association Rules Mining algorithms based on Genetic metaheuristic and Bees Swarm Optimization respectively. It shows results that concerning both the fitness criterion and the CPU time. Moreover, it shows that concerning the fitness criterion, BSO-ARM achieved slightly better than all the genetic approaches. On the other hand, BSO-ARM is more time consuming. In all cases, we observed

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that the developed approaches yield useful association rules in a short time when comparing them with previous works. In this present article, we proposed a new algorithm (BSO-ARM) for association rule mining. It's inspired by bees behavior and it's based on BSO algorithm. The two important operations (determination search area and neighborhood search) provided by BSO, permit to improve the solution quality but it requires a considerable computation time.

4 METHODOLOGY

The bees algorithm [11] mimics the foraging strategy of honey bees to look for the best solution to an optimization problem. Each candidate solution is thought of as a food source (flower), and a population (colony) of *n* agents (bees) is used to search the solution space. Each time an artificial bee visits a flower (lands on a solution), it evaluates its profitability (fitness).

The bees algorithm consists of an initialization procedure and a main search cycle which is iterated for a given number *T* of times, or until a solution of acceptable fitness is found. Each search cycle is composed of five procedures: recruitment, local search, neighborhood shrinking, site abandonment, and global search.

In the initialisation routine *ns* scout bees are randomly placed in the search space, and evaluate the fitness of the solutions where they land. For each solution, a neighbourhood (called flower patch) is delimited.

In the recruitment procedure, the scouts that visited the *nb*≤*ns* fittest solutions (best sites) perform the waggle dance. That is, they recruit foragers to search further the neighbourhoods of the most promising solutions. The scouts that located the very best *ne*≤*nb* solutions (elite sites) recruit *nre* foragers each, whilst the remaining *nb-ne* scouts recruit *nrb*≤*nre* foragers each. Thus, the number of foragers recruited depends on the profitability of the food source.

Pseudocode for the standard bees algorithm [11]

```
1.    for i=1,…,ns
            scout[i]=Initialise_scout()
            flowerpatch[i]=Initialiseflowerpatch(scout[i])
2.    do until stopping_condition=TRUE
          Recruitment()
      for i =1,...,nb
  flowerpatch[i]=Local_search(flowerpatch[i])
            flowerpatch[i]=Siteabandonment(flowerpatch[i])
            flowepatch[i]=Neighbourhoodshrinking(flowerpatc
h[i])
      for i = nb,...,ns
            flowerpatch[i]=Globalsearch(flowerpatch[i])
```

In the local search procedure, the recruited foragers are randomly scattered within the flower patches enclosing the solutions visited by the scouts (local exploitation). If any of the foragers in a flower patch lands on a solution of higher fitness than the solution visited by the scout, that forager becomes the new scout. If no forager finds a solution of higher fitness, the size of the flower patch is shrunk (neighborhood shrinking procedure). Usually, flower patches are initially defined over a large area, and their size is gradually shrunk by the neighborhood shrinking procedure. As a result, the scope of the local exploration is progressively focused on the area immediately close to the local fitness best. If no improvement in fitness is recorded in a given flower patch for a preset number of search cycles, the local maximum of fitness is considered found, the patch is abandoned (site abandonment), and a new scout is randomly generated.

As in biological bee colonies, a small number of scouts keeps exploring the solution space looking for new regions of high fitness (global search). The global search procedure re-initializes the last *ns-nb* flower patches with randomly generated solutions.

5 HELPFUL HINTS

Basically, It is based on a swarm of artificial bees cooperating together to solve a problem. Fig. 1 shows details flow of algorithm. First, a bee named InitBee (Radom Initialization) settles to find a solution presenting good features. From this first solution called Sref we determine a set of other solutions of the search space by using a certain strategy. This set of solutions is called SearchArea. Then, every bee will consider a solution from SearchArea as its starting point in the search. After accomplishing its search, every bee communicates the best visited solution to all its neighbors through a table named Dance. These table stores solutions will become the new reference solution during the next iteration. This algorithm finds optimal solution of given problem.

This bees behavior are helpful to solve different kinds of computational problems and combinatorial optimization problems.

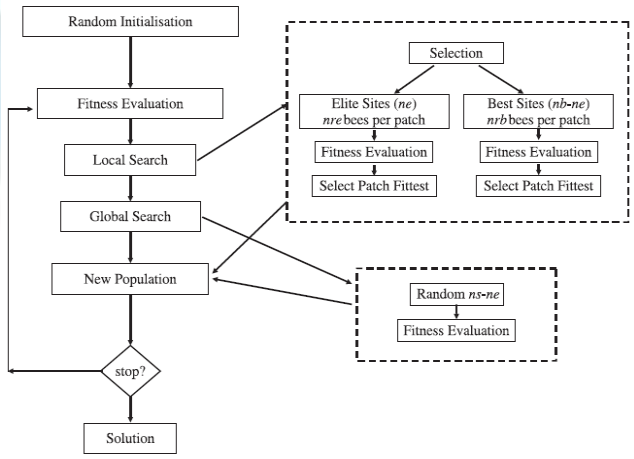

Fig. 1 Flowchart of the basic Bees Algorithm

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6 CONCLUSION

Bio inspired bees algorithm plays very important role in computer networks, data mining, power system, economics, robotics, information security, control system, image processing etc. Above discussion concludes different bees behavior approaches and basic bee algorithm can be used to solve different computer science problems. There are great opportunities of exploring or enhancing this field algorithm with the help of innovative ideas or thoughts. And these kinds of algorithms are time consuming. But again if data size increases computation time also increase. To solve such a different complex and computational problems in computer science filed, we can go for parallel programming in future.

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