MCSE662

Assignment 09: Motivation to Artificial Bee Colony (ABC) Optimization

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Artificial Bee Colony Optimization Algorithm STEP-BY-STEP with Numerical Example ~xRay Pixy

Important Points-

Artificial Bee Colony Optimization Algorithm is a Swarm Intelligence Population-Based Metaheuristic Bees are flying insects with wings. Algorithm. The artificial Bee Colony Optimization Algorithm is inspired by the behavior of bees in nature. We can use an Algorithm— Artificial Bee Colony Optimization Algorithm to solve different Engineering Optimization Problems, Numerical Problems. Bees feed on nectar as Energy Source in their life.

Algorithms Inspired by the behavior of the bees:

Bees Algorithms

Bee Hives

Bee Colony Optimization Algorithm

Artificial Bee Colony (ABC) Algorithm

Marriage Bee Optimization (MBO) Algorithm

Bee Algorithms are used to solve different problems.

Bee System: Genetics Problems.

Bee Hive: Routing Protocols.

Honey Bee Marriage: Cluster Analysis.

Bee Colony Optimization: Travelling Salesman Problems (TSP), Vehicle Routing Problem, Ride Matching Problems, Job Scheduling Problems.

Artificial Bee Colony Optimization: Engineering Problems, Numerical Optimization.

Bee Colony (BC) is a population-based metaheuristic algorithm.

A bee colony is basically inspired by a bee’s behavior in nature.

Certain Features: Nectar Exploration, Waggle Dance, Food Foraging, Division of bees, Mating during Flight.

A bee colony is based on 3 different models:

Food foraging

Nest Site Search

Marriage in the Bee Colony

Artificial Bee Colony (ABC) Optimization Algorithm

Artificial Bee Colony (ABC) Optimization Algorithm is inspired by Bee’s behavior in Nature. Artificial Bee Colony (ABC) is a Meta-heuristic algorithm based on the intelligent search behavior of Honey Bee Colony. ABC optimization algorithm is combined with both local and global search. Artificial Bee Colony (ABC) optimization algorithm is used to solve different engineering problems.

In ABC, Bee’s / Agents search for rich artificial food sources [Good Solution]. Artificial Bee Colony (ABC) optimization algorithm provides better results as compare to the Particle Swarm Optimization algorithm (PSO).

Artificial Bee Colony (ABC) Optimization Algorithm Pseudocode

Initialization Phase

REPEAT

Employee Bees Phase

Onlooker Bees Phase

Scout Bees Phase

Memories the best solution achieved.

UNTIL Stopping criteria is met.

**Artificial Bee Colony Optimization Steps**

Step 01: Generate initial population randomly (𝑋\_𝑖), i = 1,2,3,4,….Population Size

Step 02: Calculate fitness values for each agent in the population.

Step 03: Memorize the best (𝑋\_𝐵𝑒𝑠𝑡) solution in the population.

Step 04: Set Current Iteration (t = 1)

Step 05: Generate new solutions for employee bee (𝑣\_𝑖) from old solutions 〖(𝑋〗\_𝑖).

Step 06: Compute the fitness of all new solutions in the population.

Step 07: Keep the best solution between current and candidate solutions.

Step 08: Calculate the Probability (𝑃\_𝑖) for the solution 〖(𝑋〗\_𝑖).

Step 09: Generate new solutions (𝑣\_𝑖) for onlooker bees from the solution selecting depending on its 𝑃\_𝑖.

Step 10: Calculate the fitness of all new solutions in the population.

Step 11: Determined the abandoned solution if exist, replace it with a new random solution 𝑋\_𝑖.

Step 12: Keep the best solution found in the population.

Step 13: t = t+1;

Step 14: Repeat until t<=MaxT.

How Do Honeybees Get Their Jobs? | National Geographic-

Important Points-

The honeybee is one of the most collaborative insects in the world. Each hive is comprised of thousands of bees working together in order to build and sustain a colony within the colony each bee has a specific role to play a job.

These are jobs like foraging for food, tending to young larvae and building a honeycomb but with a brain about the size of a sesame seed it begs the question how do bees know what specific job they need to do in order to keep a balance in the hive.

The answer is written into the genetic makeup of each bee and it starts with the queen bee who has the unique ability to designate the sex of her children which plays a pivotal role in their future.

If the queen wants to lay a female egg she will fertilize the egg by releasing spermatozoa that is stored in the spermatheca which sit behind her ovaries the spermatheca is filled during her first week of life when she mates with up to 20 drones or male bees.

If the Queen wants to lay a male egg she will not release any spermatozoa as the egg leaves the ovaries and drones have a singular job that job is to mate with Queens from other colonies to propagate the species when they're not trying to mate they eat leisurely from the honey reserves and wait for a queen to go on her nuptial flight.

Female bees or worker bees do literally everything else they keep the cells clean care for the larvae, build cells, tend to the Queen, store honey forage, pollinate, guard the nest and even feed male bees honey if they're begging for it

Each bee knows what to do because their hormones activate the part of their genetic makeup that tells them what jobs they have to tackle and when they have to tackle it they go through four phases of jobs before dying. In phase one bees go to work immediately after they emerge from metamorphosis about three weeks after they're born, they begin cleaning the cells from which they emerge after about three days. Their hormones shift them into nurse bee mode, in this job they feed the young brood, that succeeds them this lasts for about a week. Then phase three kicks in and then workers become general handyman moving farther away from the center of the hive and doing things like building honeycomb, storing food and guarding the nest. Entrances this lasts about a week the final phase is the most dangerous, it's the foraging feast where workers leave the nest to find pollen to bring home and feed the colony. This phase starts around day 41 and lasts until about day 50. After a short life of constant work, most workers will leave the nest. As death approaches the corpses of those that die inside the hive are carried out by an undertaker bees. It's a thankless life for the worker bee but this collaboration and process has made them one of the most successful super organisms in nature.