Artificial Bee Colony (ABC) algorithm and Clustering

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Outline

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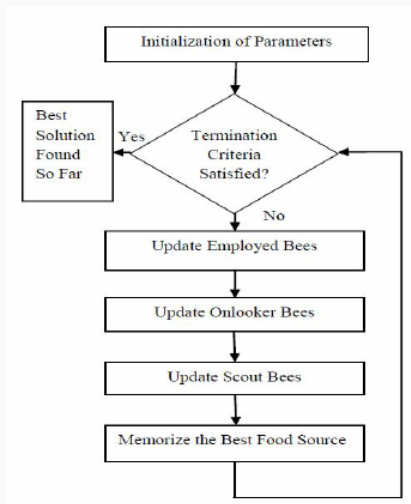
Phases

Figure 1: Phases of ABC. Source: Kumar, S. et al. (2014)

Initialization

```
1. Data
2. Generate the initial solution
3. Evaluate the nectar (fitness)
```

Parameters:

- The number of initial food sources *SN*

Simulation:

- Initial solution input
- Initial food sources

Employed bees

```
4. While (Condition not met){
5. For each employed bee{
     Produce new solution
     Greedy selection }
```

Finding neighbour

$$\nu_{ij} = z_{ij} + \phi_{ij}(z_{ij} - z_{kj})$$

Employed bees

```
4. While (Condition not met){
5. For each employed bee{
     Produce new solution
     Greedy selection }
```

Calculate fitness

$$fit_i = \frac{1}{1/f_i}$$

Onlooker bees

```
6. Calculate the probabilities of solution
7. For each onlooker bee{
    Select a solution using probabilities
    Produce new solution
    Greedy selection }
```

Calculate probabilities

$$p_i = \frac{fit_i}{\sum_{i=1}^{SN} fit_i}$$

Scout bees

```
8. Abandon non-improving solution
9. Replace it with new solution
```

Parameter:

- The limit

Scout bees

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9. Replace it with new solution

Parameter:

- The limit

Finding new solution

$$z_i^j = z_{min}^j + \delta_i^j(z_{max}^j - z_{min}^j)$$

Stopping criteria

```
10. Record the best solution }
11. End
```

Parameters:

- Maximum number of iterations
- Maximum number of unimproved global minimum

Intensification vs Diversification

Local search

Creat new solution from neighbours

- The employed bee
- The onlooker bee (with tendency)

Intensification vs Diversification

Local search

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Global search

Replace current solution using new solution found from solution space

- Abandon scheme
- The scout bee

Outline

Escaping local optim

Simulated annealing:

- Being able to accept worse solution based on temperature

Escaping local optim

Simulated annealing:

- Being able to accept worse solution based on temperature

ABC:

- Abandon solution that does not improve for many iteraions (combined with global search)

Reproduction

Genetic Algorithm:

- Selection
- Crossover
- Mutation
- Evaluation
- Update

Reproduction

Genetic Algorithm:

- Selection
- Crossover
- Mutation
- Evaluation
- Update

Each bee in ABC:

- Finding neighbour
- Creat new solution
- (Randomly)
- Calculate fitness
- Greedily select

Outline

Adjustment

Solution representation:

$k \times D$ matrix

Adjustment

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$k \times D$ matrix $\Rightarrow$ vector

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Standardization

$z_{ij}^* = \frac{z_{ij}}{\max_j |z_{ij}|}$

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Initialize different foods sources

- Evenly assigned across the solution space $\times$
- Randomly sample between bounds $\times$

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Initialize different foods sources

- Evenly assigned across the solution space $\times$
- Randomly sample between bounds $\times$
- Sample from the existing data points

Constraint and Relexation

Minimum cluster size: $\frac{n}{2d}$

Too hard to find a solution so we:

- Simulate initial input solution up to 4000 times
- Initialize food sources up to 2500 times
- Globally search in the scout bee up to 2000 times

Constraint and Relexation

Minimum cluster size: $\frac{n}{2d}$

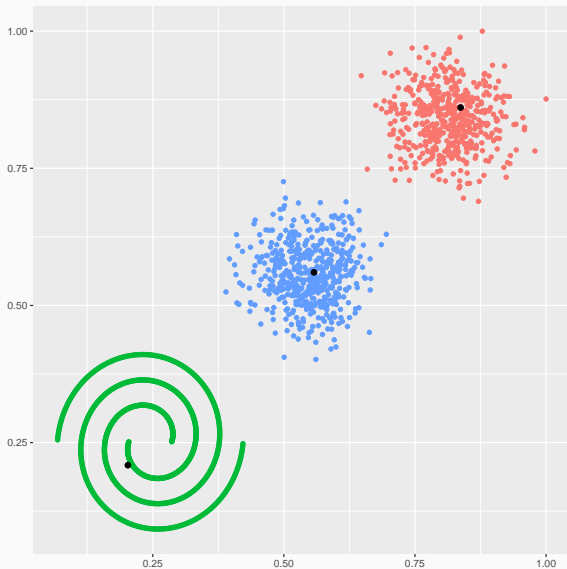Too hard to find a solution so we:

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Minimum cluster size is relaxed to $\frac{n}{10d}$ if the algorithm reaches the first two condition
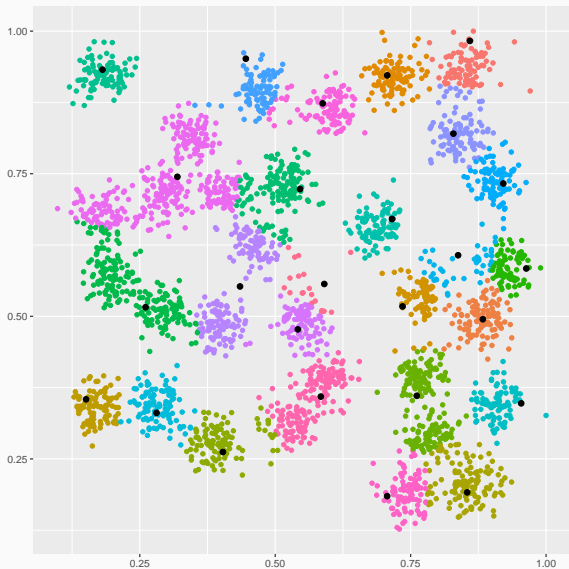
Kumar, S., Sharma, V. K., & Kumari, R. (2014).
Randomized memetic artificial bee colony algorithm.
arXiv preprint arXiv:1408.0102.