Step by Step Procedure of ABC

Consider the optimization problem as follows:

$$Minimize\ f(x) = x_1^2 + x_2^2, \qquad -5 \le x_1, x_2 \le 5$$

Control Parameters of ABC Algorithm are set as;
- Colony size, CS = 6
- Limit for scout, L = (CS*D)/2 = 6

and dimension of the problem, D = 2

First, we initialize the positions of 3 food sources (CS/2) of employed bees, randomly using uniform distribution in the range (-5, 5).

x =

1.4112	-2.5644
0.4756	1.4338
-0.1824	-1.0323

f(x) values are;

8.5678
2.2820
1.0990

Fitness function: $fit_i = \begin{cases} \frac{1}{1+f_i} & if\ f_i \ge 0 \\ 1 + abs(f_i) & if\ f_i < 0 \end{cases}$

Initial fitness vector is:

0.1045
0.3047
0.4764

Maximum fitness value is 0.4764, the quality of the best food source.

Cycle=1

//Employed bees phase

- 1st employed bee
    - $v_{i,j} = x_{i,j} + \Phi_{ij}(x_{i,j} - x_{k,j})$ with this formula, produce a new solution.
      k=1 //k is a random selected index.
      j=0 //j is a random selected index.

Φ = 0.8050 // Φ is randomly produced number in the range [-1, 1].
υ_0=
2.1644 -2.5644

- Calculate $f(\upsilon_0)$ and the fitness of υ_0.

  $f(\upsilon_0)$ = 11.2610 and the fitness value is 0.0816.

- Apply greedy selection between x_0 and υ_0

  0.0816 < 0.1045, the solution 0 couldn't be improved, increase its trial counter.

- 2nd employed bee

  - $\upsilon_{i,j} = x_{i,j} + \Phi_{ij}(x_{i,j} - x_{k,j})$ with this formula produce a new solution.
    k=2 //k is a random selected solution in the neighborhood of i.
    j=1 //j is a random selected dimension of the problem.
    Φ = 0.0762 // Φ is randomly produced number in the range [-1, 1].
    υ_1=
    0.4756 1.6217

  - Calculate $f(\upsilon_1)$ and the fitness of υ_1.

    $f(\upsilon_1)$ = 2.8560 and the fitness value is 0.2593.

  - Apply greedy selection between x_1 and υ_1

    0.2593 < 0.3047, the solution 1 couldn't be improved, increase its trial counter.

- 3rd employed bee

  - $\upsilon_{i,j} = x_{i,j} + \Phi_{ij}(x_{i,j} - x_{k,j})$ with this formula produce a new solution.
    k=0 //k is a random selected solution in the neighborhood of i.
    j=0 //j is a random selected dimension of the problem.
    Φ = -0.0671 // Φ is randomly produced number in the range [-1, 1].
    υ_2=
    -0.0754 -1.0323
  - Calculate $f(\upsilon_2)$ and the fitness of υ_2.

    $f(\upsilon_2)$ = 1.0714 and the fitness value is 0.4828.

  - Apply greedy selection between x_2 and υ_2.

0.4828 > 0.4764, the solution 2 was improved, set its trial counter as 0 and replace the solution x_2 with v_2.

x =

1.4112	-2.5644
0.4756	1.4338
-0.0754	-1.0323

f(x) values are;

8.5678
2.2820
1.0714

fitness vector is:

0.1045
0.3047
0.4828

//Calculate the probability values *p* for the solutions *x* by means of their fitness
//values by using the formula; $p_i = \frac{fit_i}{\sum_{i=1}^{CS/2} fit_i}$.

p =

0.1172
0.3416
0.5412

//Onlooker bees phase
//Produce new solutions v_i for the onlookers from the solutions x_i selected
//depending on p_i and evaluate them.

- 1st onlooker bee
  - i=2
    v_2=
    -0.0754 -2.2520
  - Calculate $f(v_2)$ and the fitness of v_2.

    $f(v_2)$ = 5.0772 and the fitness value is 0.1645.
  - Apply greedy selection between x_2 and v_2

0.1645 < 0.4828, the solution 2 couldn't be improved, increase its trial counter.

- 2nd onlooker bee
  - i=1
    υ_1=
    0.1722 1.4338
  - Calculate $f(\upsilon_1)$ and the fitness of υ_1.

    $f(\upsilon_1)$ = 2.0855 and the fitness value is 0.3241.
  - Apply greedy selection between x_1 and υ_1

    0.3241 > 0.3047, the solution 1 was improved, set its trial counter as 0 and replace the solution x_1 with υ_1.

    x =
    1.4112 -2.5644
    0.1722 1.4338
    -0.0754 -1.0323

    $f(x)$ values are;
    8.5678
    2.0855
    1.0714

    fitness vector is:
    0.1045
    0.3241
    0.4828

- 3rd onlooker bee
  - i=2
    υ_2=
    0.0348 -1.0323
  - Calculate $f(\upsilon_2)$ and the fitness of υ_2.

    $f(\upsilon_2)$ = 1.0669 and the fitness value is 0.4838.
  - Apply greedy selection between x_2 and υ_2

0.4838 > 0.4828, the solution 2 was improved, set its trial counter as 0 and replace the solution x_2 with v_2.

x =

1.4112	-2.5644
0.1722	1.4338
0.0348	-1.0323

f(x) values are;

8.5678
2.0855
1.0669

fitness vector is:

0.1045
0.3241
0.4838

//Memorize best
Best =

0.0348 -1.0323

//Scout bee phase
TrialCounter =

1
0
0

//There is no abandoned solution since L = 6
//If there is an abandoned solution (the solution of which the trial counter value is //higher than L = 6); generate a new solution randomly to replace with the //abandoned one.
Cycle = Cycle+1

The procedure is continued until the termination criterion is attained.