CROW SEARCH OPTIMIZATION ALGORITHM

Crow Search Algorithm

Crow Search Optimization is similar to Particle Swarm Optimization.

Developed by Alireza Askarzadeh in 2016.

Metaheuristic Algorithm

CROW SEARCH OPTIMIZATION ALGORITHM

CSO is a Population based algorithm.

About Crow

- Highly Intelligent Bird [known for their intelligence)].
- Live in large families.
- Crow can **remember faces** and warn its species in danger.
- Crow can Hide food and remember its location.
- Age : 14 to 17 years.
- Upto 40 different species of crows (different size).

CROW SEARCH OPTIMIZATION ALGORITHM

- Crow search algorithm is based on intelligent behavior of crows.
- Crow can memorize the hiding place positions.
- They follow each other to steal their food.
- Crows protect their hiding places from attackers.
- Two main parameters used in CSO algorithm:
  1. Flights Length,
  2. Awareness Probability.

CROW SEARCH OPTIMIZATION ALGORITHM

CSO Algorithm Main Concept 01

"Crow store excess food in hiding places and retrieve it when needed".

Crows can memorize hidden places & retrieve the hidden food even after several days / months.

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CSO Algorithm Main Concept 02

"They can cheat other crows by following the other crows [i.e., to watch their hidden places] in order to steal their hidden food.

CROW SEARCH OPTIMIZATION ALGORITHM

STEP 02 : Compute Fitness Value for Each Crow

- **Number_Of_Crows = 20** (*Population Size*)

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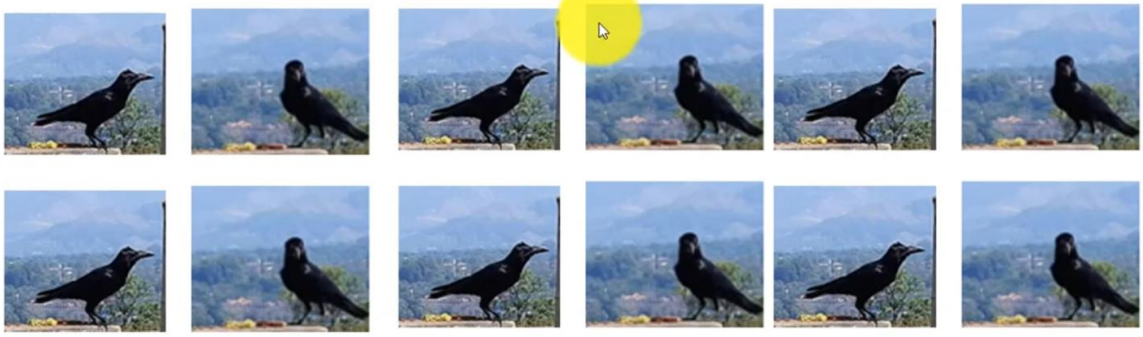
STEP 01 : Initialize Crows Population Randomly

- Assume we have total **Number_Of_Crows = 20** (*Population Size*)
- **MaxT = 200;** (*Maximum number of iterations*)
- x_i^t = Position of Crow i at iteration t.
- Where, i = Number of Crows (i.e., i = 1,2,3,4,5,6,7,8,…20).
- t = Current Iteration (i.e., t = 1,2,3,4,5….200).

CROW SEARCH OPTIMIZATION ALGORITHM

STEP 02 : Compute Fitness Value for Each Crow

- **Number_Of_Crows = 20** (*Population Size*)



STEP 03 : Initialize the Memory of each crow.

- Each crow has memory in which positions of hidden places is memorized.
- In initialize stage, crows have no memory.
- M_i^t = Best Position of Crow (i) at iteration (t).

Assume : They have hidden their foods at their initial positons.

STEP 04 : Move in the surrounding for better Food / hiding places.

- For food theft, crows chase/follow each other.
- Suppose,

CROW I

CROW J

Crow J want to visit its food hiding place.

I want to see my hidden food.

STEP 04 : Move in the surrounding for better Food / hiding places.

- For food theft, crows chase/follow each other.
- Suppose,

For Food Theft, Crow I decided to follow Crow J.

I will steal his food.

CROW I

CROW J

STEP 04 : Move in the surrounding for better Food / hiding places.

- For food theft, crows chase/follow each other.
- Suppose,

For Food Theft, Crow I decided to follow Crow J.

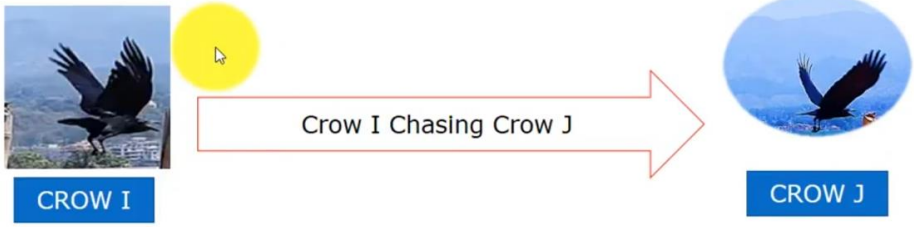
CROW I

CROW J

STEP 04 : Move in the surrounding for better Food / hiding places.

- For food theft, crows chase/follow each other.

CASE 1 : Crow J don't know Crow I following him.



OUTPUT : Crow I discovered / approaches Crow J food hiding place.

New Position of Crow I can be obtained by using this equation

$$Position_i^{t+1} = Position_i^t + r_i * Flight_i^t * (Memory_i^t - Position_i^t)$$

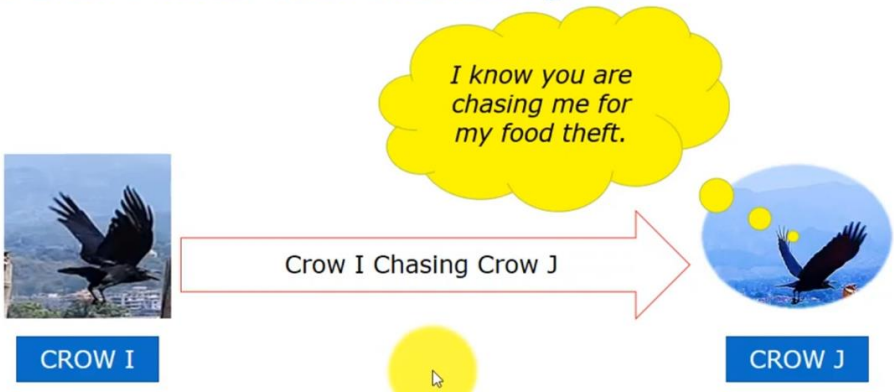
Random Number with uniform distribution [0,1]

Flight Length

Position Update for CROW I

STEP 04 : Move in the surrounding for better Food / hiding places.

CASE 2 : Crow J know Crow I following him.



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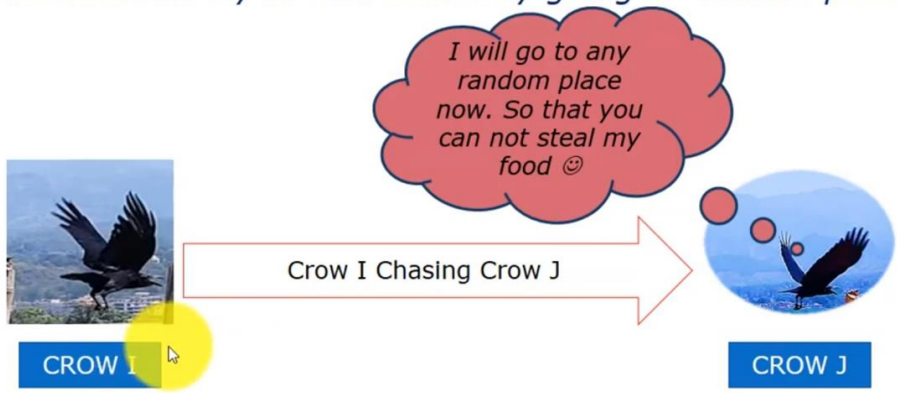
CASE 2 : *Crow J will try to fool Crow I by going to another position.*



CASE 2 : *Crow J will try to fool Crow I by going to another position.*

CROW I

Crow I Chasing Crow J

CROW J

CASE 1 : Crow J don't know Crow I following him.

CASE 2 : Crow J know Crow I following him.

For Case 02:

$$x^{i,\text{iter}+1} = \begin{cases} x^{i,\text{iter}} + r_i \times fl^{i,\text{iter}} \times (m^{j,\text{iter}} - x^{i,\text{iter}}) & r_j \geq AP^{j,\text{iter}} \\ \text{a random position} & \text{otherwise} \end{cases}$$

IF $(r_j \leq AP_j^t)$

A random position.

End

Here, AP = Awareness probability of Crow J.

CASE 1 : Crow J don't know Crow I following him.

CASE 2 : Crow J know Crow I following him.

For Case 01:

$$x^{i,\text{iter}+1} = \begin{cases} x^{i,\text{iter}} + r_i \times fl^{i,\text{iter}} \times (m^{j,\text{iter}} - x^{i,\text{iter}}) & r_j \geq AP^{j,\text{iter}} \\ \text{a random position} & \text{otherwise} \end{cases}$$

IF $(r_j \geq AP_j^t)$

$$Position_i^{t+1} = Position_i^t + r_i * Flight_i^t * (Memory_i^t - Position_i^t)$$

End

Here, AP = Awareness probability of Crow J.

STEP 04 : Move in the surrounding for better Food / hiding places.

- while (t < MaxT)

for i : 1 to N (N = Total_NumberOF_Crows i.e., 20)

Randomly choose one crow (say j) to follow.

Define awareness probability (AP).

if ($r_j \geq AP_j^t$)

Update $x_i^{t+1} = x_i^t + r_i \text{ X } Flight_i^t \text{ X } (Memory_j^t - x_i^t)$.

else

$Update\ x_i^{t+1}$ Rabdomly.

End For

Crow Search Algorithm applied to different optimization problem:

1. In Chemical engineering
2. For Feature Selection
3. In image processing
4. In medical Field
5. In Power Energy