

# Topic 16 - Firefly Search and Cuckoo Search

(1)

Wednesday, April 27

## Announcements:

- HW 5 due the last day of class <sup>Mon, May 9</sup> 11:59pm
- Final will be takehome, due Mon, May 16, 11:59pm

## Firefly Search

Fireflies use their lights to attract each other, and the level of attraction depends on the intensity of the light.

Population Metaheuristic, similar to PSO with different movement rules.

Each firefly represents a solution (a point in space). A firefly's movement in each step is toward every other brighter firefly (brighter = better solution), plus a random component (Lévy flight or Gaussian walk).

Suppose firefly  $j$  is brighter than firefly  $i$   
(solution  $j$  is better than solution  $i$ )

The attractiveness of  $i$  to  $j$  is:

$$A_{ij} = \beta e^{-\gamma r_{ij}^2}$$

where  $r_{ij}$  is the Euclidean distance between the two fireflies, and  $\beta$  and  $\gamma$  are parameters that you can set.

\* Attractiveness decays exponentially by the square of the distance.

So, in each generation, we loop through all pairs of fireflies and move the dimmer one toward the brighter one:

$$x_i' = x_i + \underbrace{\beta e^{-\gamma r_{ij}^2}}_{\substack{\text{attractiveness} \\ A_{ij}}} \cdot \underbrace{(x_j - x_i)}_{\substack{\text{vector pointing} \\ \text{from } x_i \text{ to } x_j}} + \underbrace{\alpha \cdot s \cdot L}_{\substack{\text{Lévy jump} \\ \text{in } d\text{-dimens.}}} \cdot \underbrace{L}_{\substack{\text{random vector} \\ \text{tuning parameter}}}$$

$x_i'$  = new pos.  
 $x_i$  = old pos.

$\alpha$  = tuning parameter

$L$  = Lévy jump in  $d$ -dimens.  
 $L$  = random vector

$\bullet$  = vectors

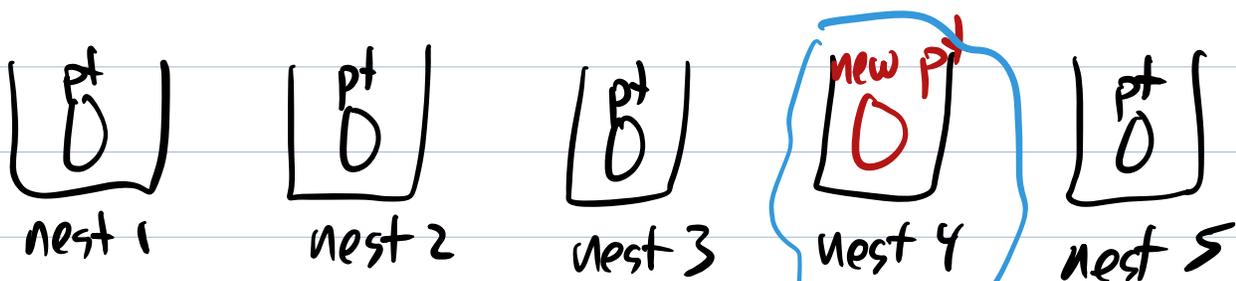


care of them. The other birds sometimes get mad and fly away to make new nests.

Idea:  $N$  nests. Each nest contains one egg.  
eggs = solutions.

Repeat:

- \* pick a random nest. Its egg is a sol.
- \* form a new solution by tweaking with a Lévy flight.
- \* pick a new random nest, and if the new solution is better than the egg in that nest, replace it



- \* take the worst  $p\%$  of eggs in any of the nests, and replace them all by tweaking with a Lévy flight.