

Friday, May 5, 2023

Lecture #43

MSSC 6000

①

Announcements

- * Homework 6 due tonight, 11:59pm
- * Final Exam (take-home) assigned today due Friday May 12, 11:59pm
- * I will have some office hours next week, probably on Teams, time TBD

Topic 16 - Firefly Search and Cuckoo Search
Suppose firefly j is brighter than firefly i .
The attractiveness of j to i is:

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

where r_{ij} is the Euclidean distance between the two fireflies, and β and γ are parameters that we can tune.

Attractiveness decays exponentially according to $\frac{1}{r_{ij}^2}$ the square of the distance.

Movement:

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

$$x_i' = x_i + \beta e^{-\gamma r_{ij}^2} (x_j - x_i) + \alpha \cdot s \cdot L$$

Annotations for the formula above:

- x_i' : new pos
- x_i : old pos
- $\beta e^{-\gamma r_{ij}^2}$: A_{ij} attractiveness
- $(x_j - x_i)$: vector from x_i to x_j
- α : tuning param
- s : random vector of ± 1
- L : Levy flight in d-dimension

Pseudocode:

$N = \#$ of fireflies

while True:

 for i from 1 to N :

 for j from 1 to N :

 if firefly j is brighter than i :

 [move i toward j according to the formula

(demos)

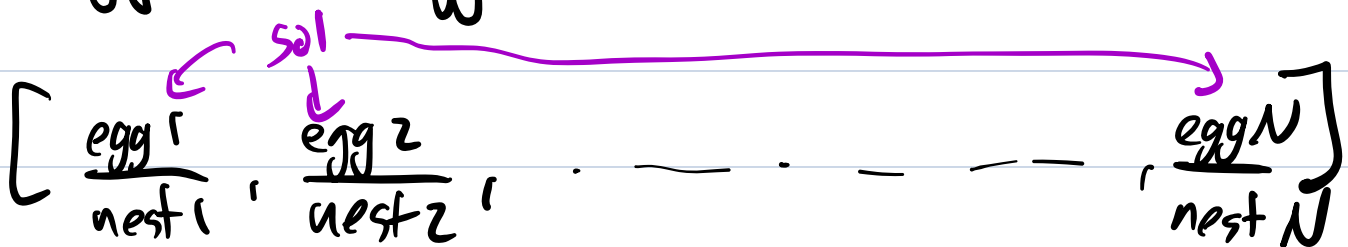
3

Cuckoo Search

Cuckoo birds are parasites — they lay their eggs in the nests of other birds so that the other birds take care of them.

The other birds sometimes get mad and fly away and make a new nest somewhere else.

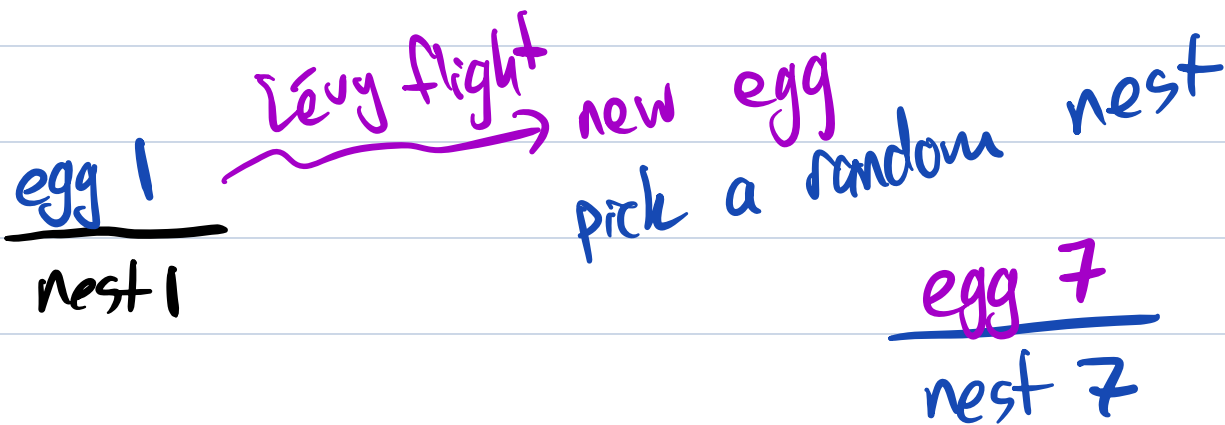
Idea: N nests. Each nest contains one egg. The egg represents a solution.



Repeat the following:

(4)

- * Pick a random nest. (The egg in that nest is a solution.)
- * Tweak that egg by doing a Lévy flight. multiply by α to scale it
- * Pick a new random nest. If the result of your Lévy flight is better than the egg in this new nest, replace it.



If new egg has a better score than egg 7, delete egg 7, and put "new egg" in nest 7.

- * Take the worst $p\%$ of eggs in nests, replace each of them with

a new egg by doing a Lévy flight from the old egg- (5)

Two notes:

* Guaranteed to hang on to good solutions.

* Could work pretty easily for discrete spaces. You need a "Lévy-flight" style tweak. One that is normally small but occasionally a big change.