

# Cuckoo Search

## A Nature-Inspired Optimization Algorithm

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### Introduction

Yang and Deb created the cuckoo search algorithm in 2009. It was inspired by the cuckoo birds. Cuckoo birds lay their eggs in the nests of the other host birds. The first fundamental motivation for developing a new optimization algorithm is cuckoo egg laying and breeding. If the host bird recognizes the eggs as not being their own then it will either throw the eggs away from its nest or simply empty the nest and build a new one.

### Algorithm

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**Algorithm 1:** The Cuckoo Search Algorithm

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Objective function  $f(X)$ ,  $X = (x_1, x_2, \dots, x_d)^T$   
Generate initial population of  $n$  host nests  $X_i (i = 1, 2, \dots, n)$   
while  $t < \text{Max iterations}$  do  
    Get a cuckoo randomly by Levy flights;  
    Evaluate its quality fitness  $F_i$ ;  
    Choose a nest among  $n$  (say,  $j$ ) randomly ;  
    if  $F_i > F_j$  then  
        replace  $j$  by the new solution;  
    end  
    if A fraction ( $Pa$ ) of worse nets are abandoned and new ones  
        are built then  
        Keep the best solutions  
        Rank the solutions and find the current best  
    end  
end  
Postprocess results and visualization
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Figure 1: Cuckoo Search Algorithm

## Steps

### Initialization

Cuckoo birds prefer to lay their eggs in the nests of other birds.

### Levy Flight

It is a random flight or walk. The steps are defined in terms of step lengths that have a certain probability distribution with random directions. This type of flight is observed in different animals and insects. The following movement is determined by the current position.

### Fitness Calculation

Calculation of fitness is achieved by using the fitness function to find the best solution. Nest is chosen randomly. The fitness of the cuckoo egg (new solution) is then compared to that of the host eggs (solutions) in the nest. If the value of the cuckoo egg's fitness function is less than or equal to the value of the randomly chosen nest's fitness function, the randomly chosen nest is replaced by the new solution.

### Termination

The fitness function compares the solutions in the current iteration and only the best solution is passed further. If the number of iterations is less than the maximum, the best nest is retained. All cuckoo birds are ready for their next actions after completing the initialization, levy flight, and fitness calculation processes. The cuckoo search algorithm will be terminated once the maximum number of iterations has been reached. These steps are applicable to any optimization problem. In such cases, each cuckoo egg and cuckoo nest play an important role.

## Implementation

GitHub Repo: [github.com/jameelkaisar/cuckoo-search](https://github.com/jameelkaisar/cuckoo-search)