



# Lion Optimization Algorithm (LOA): A nature-inspired metaheuristic algorithm

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## Abstract

During the past decade, solving complex optimization problems with metaheuristic algorithms has received considerable attention among practitioners and researchers. Hence, many metaheuristic algorithms have been developed over the last years. Many of these algorithms are inspired by various phenomena of nature. In this paper, a new population based algorithm, the Lion Optimization Algorithm (LOA), is introduced. Special lifestyle of lions and their cooperation characteristics has been the basic motivation for development of this optimization algorithm. Some benchmark problems are selected from the literature, and the solution of the proposed algorithm has been compared with those of some well-known and newest meta-heuristics for these problems. The obtained results confirm the high performance of the proposed algorithm in comparison to the other algorithms used in this paper.

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**Keywords:** Lion Optimization Algorithm (LOA); Global optimization; Metaheuristic

## 1. Introduction

Many engineering optimization problems are usually quite difficult to solve, and many applications have to deal with these complex problems. In these problems, search space grows exponentially with the problem size. Therefore, the traditional optimization methods do not provide a suitable solution for them. Hence, over the past few decades, many meta-heuristic algorithms have been designed to solve such problems. Researchers have shown good performance of meta-heuristic algorithms in a wide range of complex problems such as scheduling problems [1–6], data clustering [7,8], image and video processing [9–12], tuning of neural networks [13–15] and pattern recognition [16–18], etc.

For many years, human have utilized the guidance of nature in finding the most appropriate solution for problems. Hence, during the last decades, there has been a growing attempt in developing algorithms inspired by nature [19–21]. For example, Genetic algorithm was proposed by Holland [22], and

simulates Darwinian evolution concepts. Artificial Immune Systems [23], simulate biological immune systems for optimization. Ant Colony Optimization [24] was inspired by behavior of ants foraging for food. Particle Swarm Optimization [25] mimics the social behavior of a flock of migrating birds trying to reach an unknown destination. Marriage in Honey Bee Optimization Algorithm (MBO) was proposed by Abbass [26], and mimics processes of reproduction in the honey bee colony. Bacterial Foraging Algorithm [27] simulates search and optimal foraging of bacteria. The Shuffled Frog Leaping algorithm [28] was inspired by a frog population searching for food. The Cat Swarm algorithm [29] was developed based on the behavior of cats. Invasive weed optimization was proposed by Mehrabian and Lucas [30], and mimics the ecological behavior of colonizing weeds. Monkey Search [31] simulates a monkey in search for food resources. Water flow-like algorithm [32] was inspired by water flowing from higher to lower levels. Biogeography-based optimization algorithm was introduced by Simon [33], and inspired by biogeography which refers to the study of biological organisms in terms of geographical distribution (over time and space). The Fish

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