# Theoretical Analysis of Nature-Inspired Optimization Algorithms

**(A tutorial at EANN 2018)**

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Many problems in optimization and computational intelligence are very challenging to solve, and some of these problems can be NP-hard, which means that there are often no efficient algorithms to tackle such hard problems. In many cases, nature-inspired metaheuristic algorithms can be a good alternative and such algorithms include genetic algorithms (GA), particle swarm optimization (PSO), ant colony optimization (ACO), cuckoo search and many others. Over the last two decades, nature-inspired optimization algorithms have become increasingly popular in solving large-scale, nonlinear, global optimization with many real-world applications. They also become an important of part of optimization and computational intelligence. This tutorial will provide a critical analysis of recent algorithms using mathematical theories such as Markov chains, dynamic systems, random walks and self-organization systems. This will provide some insight into these algorithms concerning their convergence rates and stability.

**Topics and Format:**

This tutorial intends to introduce the fundamentals and latest advances of the state-of-the-art nature-inspired algorithms with the focus on mathematical analysis on new algorithms using a unified theoretical framework of Markov chain theory, random walks, dynamic systems and self-organization theory. Topics include

- Essence of an evolutionary algorithm
- Mathematical analysis of algorithms using Markov chains and self-organization
- Convergence and stability using dynamic systems and Markov chain theory
- Review of some recent theoretical results concerning evolutionary algorithms
- Introduction of selected case studies in applications with demo codes in Matlab

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