

Book review

DORIGO, M. & STÜTZLE, T. 2004: Ant Colony Optimization. – The MIT Press, Cambridge MA, 328 pp.

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Few people with an interest in biological system modelling have never heard of Ant Colony Optimization (ACO). It is the single, most well-known example of what has come to be called "bio-inspired" algorithms, and one of the most impressive success stories of translating biological phenomena into engineering solutions. The interest of ACO lies in its simplicity and versatility: It has been successfully applied to problems as diverse as network routing, industrial scheduling in metal casting and logistics with a nonhomogeneous fleet of trucks.

In spite of ACO's huge success and its relevance to many fields outside computer science, up to now know-how of this field has been spread out over many scientific publications without an obvious starting point. A book by the inventor of the ACO metaheuristic and leading expert on Ant Colony Optimization, Marco Dorigo, attempts to change this by providing a comprehensive introduction to this topic.

The ACO algorithm uses a number of artificial agents ("ants") to solve optimization problems, such as finding the shortest route for visiting a number of cities. Like many real ant species, the artificial agents in ACO lay down paths of pheromones between locations. The amount of pheromone deposited depends on the number of ants using the path. This, coupled with the fact that ants have a preference for well marked paths, is enough to guarantee a successful and surprisingly robust search algorithm. By tuning additional parameters such as the pheromone evaporation rate, the algorithm's performance can be improved.

The two authors are both leading experts on the subject. Marco Dorigo is the inventor of the ACO metaheuristic and author of numerous books on the subject. Thomas Stützle specializes in stochastic local search methods and is Assistant Professor at the TU Darmstadt where he is also head of the Metaheuristics Unit.

The book starts out with a short presentation of the elegant double-bridge experiments by Deneubourg & al. that formed the basis of the ACO algorithm, followed by a well paced introduction to the principles of ACO. It then introduces the general version of the algorithm, the ACO metaheuristic, and compares it to other general optimization methods. After a more rigorous mathematical analysis in chapter 4, which is the only chapter requiring some deeper knowledge of probability theory, ACO is applied to a number of different optimization problems including routing, assignment, subset and scheduling problems. After a more detailed explanation of a particular algorithm used for network routing ("AntNet"), the book concludes with a summary of progress in the field and an outline of future research directions.

Each chapter is concluded by a short section containing bibliographical remarks, which gives pointers to further reading on the topic, as well as a convenient summary of "things to remember". The book includes a number of "thought and computer exercises" for each chapter, which are valuable for self study and may also serve as a good guideline for preparing exercises.

The clear and concise explanations are, with the exception of a few well defined technical terms, free of scientific jargon. Unlike most books on theoretical topics, explanations always start with a simple motivational example stated in layman terms before the actual formal problem description. This not only serves as a motivation, but also helps in immediately capturing the essence of a problem. Although probably intended as a textbook, the book's clear organisation and rich contents as well as its long list of references make it also suitable as a work of reference. Clearly, the book has benefitted from both, the authors' experience in teaching and their substantial knowledge of the subject.

The two authors have succeeded in writing a comprehensive and easily readable introduction to the field of Ant Colony Optimization. ACO is essential reading for everyone working in optimization and will appeal to everybody who has an interest in biological modelling.