



# Ant Colony

**Marco Dorigo**



## **Ant Colony:**

Ant Colony Optimization Helio Barbosa, 2013-02-20 Ant Colony Optimization ACO is the best example of how studies aimed at understanding and modeling the behavior of ants and other social insects can provide inspiration for the development of computational algorithms for the solution of difficult mathematical problems Introduced by Marco Dorigo in his PhD thesis 1992 and initially applied to the travelling salesman problem the ACO field has experienced a tremendous growth standing today as an important nature inspired stochastic metaheuristic for hard optimization problems This book presents state of the art ACO methods and is divided into two parts I Techniques which includes parallel implementations and II Applications where recent contributions of ACO to diverse fields such as traffic congestion and control structural optimization manufacturing and genomics are presented

**Ant Colony Optimization and Swarm Intelligence** Marco Dorigo, 2004-08-19 This book constitutes the refereed proceedings of the 4th International Workshop on Ant Colony Optimization and Swarm Intelligence ANTS 2004 held in Brussels Belgium in September 2004 The 22 revised full papers 19 revised short papers and 9 poster abstracts presented were carefully reviewed and selected from 79 papers submitted The papers are devoted to theoretical and foundational aspects of ant algorithms ant colony optimization and swarm intelligence and deal with a broad variety of optimization applications in networking and operations research

**Decision Tree and Ensemble Learning Based on Ant Colony Optimization** Jan Kozak, 2018-06-20 This book not only discusses the important topics in the area of machine learning and combinatorial optimization it also combines them into one This was decisive for choosing the material to be included in the book and determining its order of presentation Decision trees are a popular method of classification as well as of knowledge representation At the same time they are easy to implement as the building blocks of an ensemble of classifiers Admittedly however the task of constructing a near optimal decision tree is a very complex process The good results typically achieved by the ant colony optimization algorithms when dealing with combinatorial optimization problems suggest the possibility of also using that approach for effectively constructing decision trees The underlying rationale is that both problem classes can be presented as graphs This fact leads to option of considering a larger spectrum of solutions than those based on the heuristic Moreover ant colony optimization algorithms can be used to advantage when building ensembles of classifiers This book is a combination of a research monograph and a textbook It can be used in graduate courses but is also of interest to researchers both specialists in machine learning and those applying machine learning methods to cope with problems from any field of R D

Theoretical and Practical Aspects of Ant Colony Optimization Christian Blum, 2004 Combinatorial optimization problems are of high academical and practical importance Unfortunately many of them belong to the class of NP hard problems and are therefore intractable In other words as their dimension increases the time needed by exact methods to find an optimal solution grows exponentially Metaheuristics are approximate methods for attacking these problems An approximate method is a technique that is applied

in order to find a good enough solution in a reasonable amount of time Examples of metaheuristics are simulated annealing tabu search evolutionary computation and ant colony optimization ACO the subject of this book The contributions of this book to ACO research are twofold First some new theoretical results are proven that improve our understanding of how ACO works Second a new framework for ACO algorithms is proposed that is shown to perform at the state of the art level on some important combinatorial optimization problems such as the k cardinality tree problem and the group shop scheduling problem which is a general shop scheduling problem that includes among others the well known job shop scheduling and the open shop scheduling problems

Ant Colony Optimization Avi Ostfeld, 2011-02-04 Ants communicate information by leaving pheromone tracks A moving ant leaves in varying quantities some pheromone on the ground to mark its way While an isolated ant moves essentially at random an ant encountering a previously laid trail is able to detect it and decide with high probability to follow it thus reinforcing the track with its own pheromone The collective behavior that emerges is thus a positive feedback where the more the ants following a track the more attractive that track becomes for being followed thus the probability with which an ant chooses a path increases with the number of ants that previously chose the same path This elementary ant s behavior inspired the development of ant colony optimization by Marco Dorigo in 1992 constructing a meta heuristic stochastic combinatorial computational methodology belonging to a family of related meta heuristic methods such as simulated annealing Tabu search and genetic algorithms This book covers in twenty chapters state of the art methods and applications of utilizing ant colony optimization algorithms New methods and theory such as multi colony ant algorithm based upon a new pheromone arithmetic crossover and a repulsive operator new findings on ant colony convergence and a diversity of engineering and science applications from transportation water resources electrical and computer science disciplines are presented

*Ant Colony Optimization* Marco Dorigo, Thomas Stutzle, 2004-06-04 An overview of the rapidly growing field of ant colony optimization that describes theoretical findings the major algorithms and current applications The complex social behaviors of ants have been much studied by science and computer scientists are now finding that these behavior patterns can provide models for solving difficult combinatorial optimization problems The attempt to develop algorithms inspired by one aspect of ant behavior the ability to find what computer scientists would call shortest paths has become the field of ant colony optimization ACO the most successful and widely recognized algorithmic technique based on ant behavior This book presents an overview of this rapidly growing field from its theoretical inception to practical applications including descriptions of many available ACO algorithms and their uses The book first describes the translation of observed ant behavior into working optimization algorithms The ant colony metaheuristic is then introduced and viewed in the general context of combinatorial optimization This is followed by a detailed description and guide to all major ACO algorithms and a report on current theoretical findings The book surveys ACO applications now in use including routing assignment scheduling subset machine learning and bioinformatics problems AntNet an ACO algorithm designed for the

network routing problem is described in detail The authors conclude by summarizing the progress in the field and outlining future research directions Each chapter ends with bibliographic material bullet points setting out important ideas covered in the chapter and exercises Ant Colony Optimization will be of interest to academic and industry researchers graduate students and practitioners who wish to learn how to implement ACO algorithms **The Ants** Bert Hölldobler, Edward O. Wilson, 1990 This landmark work is a thoroughgoing survey of one of the largest and most diverse groups of animals on the planet Hölldobler and Wilson review in exhaustive detail virtually all topics in the anatomy physiology social organization ecology and natural history of the ants *Ant Colony Optimization and Applications* Stefka Fidanova, 2021-02-27 This book is interesting and full of new ideas It provokes the curiosity of the readers The book targets both researchers and practitioners The students and the researchers will acquire knowledge about ant colony optimization and its possible applications as well as practitioners will find new ideas and solutions of their combinatorial optimization and decision making problems Ant colony optimization is between the best method for solving difficult optimization problems arising in real life and industry It has obtained distinguished results on some applications with very restrictive constraints The reader will find theoretical aspects of ant method as well as applications on a variety of problems The following applications could be mentioned multiple knapsack problem which is an important economical problem grid scheduling problem GPS surveying problem E coli cultivation modeling wireless sensor network positioning image edges detection workforce planning

#### **Introduction to Genetic Algorithms** S.N. Sivanandam, S. N. Deepa, 2007-10-24

The origin of evolutionary algorithms was an attempt to mimic some of the processes taking place in natural evolution Although the details of biological evolution are not completely understood even nowadays there exist some points supported by strong experimental evidence Evolution is a process operating over chromosomes rather than over organisms The former are organic tools encoding the structure of a living being i.e. a creature is built decoding a set of chromosomes Natural selection is the mechanism that relates chromosomes with the efficiency of the entity they represent thus allowing that efficient organism which is well adapted to the environment to reproduce more often than those which are not The evolutionary process takes place during the reproduction stage There exists a large number of reproductive mechanisms in Nature Most common ones are mutation that causes the chromosomes of offspring to be different to those of the parents and recombination that combines the chromosomes of the parents to produce the offspring Based upon the features above the three mentioned models of evolutionary computing were independently and almost simultaneously developed **Agent and Multi-Agent**

**Systems: Technologies and Applications** Geun Sik Jo, Lakhmi Jain, 2008-03-14 Following from the very successful First KES Symposium on Agent and Multi Agent Systems Technologies and Applications KES AMSTA 2007 held in Wroclaw Poland 31 May 1 June 2007 the second event in the KES AMSTA symposium series KES AMSTA 2008 was held in Incheon Korea March 26 28 2008 The symposium was organized by the School of Computer and Information Engineering Inha University

KES International and the KES Focus Group on Agent and Multi agent Systems The KES AMSTA Symposium Series is a sub series of the KES Conference Series The aim of the symposium was to provide an international forum for scientific research into the technologies and applications of agent and multi agent systems Agent and multi agent systems are related to the modern software which has long been recognized as a promising technology for constructing autonomous complex and intelligent systems A key development in the field of agent and multi agent systems has been the specification of agent communication languages and formalization of ontologies Agent communication languages are intended to provide standard declarative mechanisms for agents to communicate knowledge and make requests of each other whereas ontologies are intended for conceptualization of the knowledge domain The symposium attracted a very large number of scientists and practitioners who submitted their papers for nine main tracks concerning the methodology and applications of agent and multi agent systems a doctoral track and two special sessions

*Ant Colony Optimization Algorithms* Fouad Sabry, 2023-07-01 What Is Ant Colony Optimization Algorithms The Ant Colony Optimization Algorithm also known as ACO is a probabilistic technique for addressing computational problems in the fields of computer science and operations research These problems can be boiled down to the task of finding good paths through graphs The behavior of natural ants served as inspiration for the development of multi agent systems which are represented by artificial ants The communication of biological ants through the use of pheromones is frequently the major paradigm that is adopted Combinations of artificial ants and local search algorithms have become the technique of choice for several optimization tasks involving some kind of graph such as internet routing and vehicle routing This is because these combinations are able to find optimal solutions more quickly than traditional methods How You Will Benefit I Insights and validations about the following topics Chapter 1 Ant colony optimization algorithms Chapter 2 Job shop scheduling Chapter 3 Open shop scheduling Chapter 4 Quadratic assignment problem Chapter 5 Generalized assignment problem Chapter 6 Set cover problem Chapter 7 Partition problem Chapter 8 Bankruptcy prediction Chapter 9 Protein protein interaction Chapter 10 Protein folding II Answering the public top questions about ant colony optimization algorithms III Real world examples for the usage of ant colony optimization algorithms in many fields Who This Book Is For Professionals undergraduate and graduate students enthusiasts hobbyists and those who want to go beyond basic knowledge or information for any kind of ant colony optimization algorithms What is Artificial Intelligence Series The artificial intelligence book series provides comprehensive coverage in over 200 topics Each ebook covers a specific Artificial Intelligence topic in depth written by experts in the field The series aims to give readers a thorough understanding of the concepts techniques history and applications of artificial intelligence Topics covered include machine learning deep learning neural networks computer vision natural language processing robotics ethics and more The ebooks are written for professionals students and anyone interested in learning about the latest developments in this rapidly advancing field The artificial intelligence book series provides an in depth yet accessible exploration from the fundamental

concepts to the state of the art research With over 200 volumes readers gain a thorough grounding in all aspects of Artificial Intelligence The ebooks are designed to build knowledge systematically with later volumes building on the foundations laid by earlier ones This comprehensive series is an indispensable resource for anyone seeking to develop expertise in artificial intelligence

**Advances in Neural Networks -- ISSN 2010** Bao-Liang Lu,2010-05-21 This book and its sister volume constitutes the proceedings of the 7th International Symposium on Neural Networks ISSN 2010 held in Shanghai China June 6 9 2010 The 170 revised full papers of Part I and Part II were carefully selected from 591 submissions and focus on topics such as Neurophysiological Foundation Theory and Models Learning and Inference and Neurodynamics The second volume Part II LNCS 6064 covers the following 5 topics SVM and Kernel Methods Vision and Image Data Mining and Text Analysis BCI and Brain Imaging and applications

**Ant Colony Optimization and Constraint Programming** Christine Solnon,2013-03-04 Ant colony optimization is a metaheuristic which has been successfully applied to a wide range of combinatorial optimization problems The author describes this metaheuristic and studies its efficiency for solving some hard combinatorial problems with a specific focus on constraint programming The text is organized into three parts The first part introduces constraint programming which provides high level features to declaratively model problems by means of constraints It describes the main existing approaches for solving constraint satisfaction problems including complete tree search approaches and metaheuristics and shows how they can be integrated within constraint programming languages The second part describes the ant colony optimization metaheuristic and illustrates its capabilities on different constraint satisfaction problems The third part shows how the ant colony may be integrated within a constraint programming language thus combining the expressive power of constraint programming languages to describe problems in a declarative way and the solving power of ant colony optimization to efficiently solve these problems

**Nature Inspired Cooperative Strategies for Optimization (NISCO 2007)** Natalio Krasnogor,Vincenzo Nicosia,Mario Pavone,David Alejandro Pelta,2008-05-14 Biological and natural processes have been a continuous source of inspiration for the sciences and engineering For instance the work of Wiener in cybernetics was influenced by feedback control processes observable in biological systems McCulloch and Pitts description of the artificial neuron was instigated by biological observations of neural mechanisms the idea of survival of the fittest inspired the field of evolutionary algorithms and similarly artificial immune systems ant colony optimisation automated self assembling programming membrane computing etc also have their roots in natural phenomena The second International Workshop on Nature Inspired Cooperative Strategies for Optimization NISCO was held in Acireale Italy during November 8 10 2007 The aim for NISCO 2007 was to provide a forum where the latest ideas and state of the art research related to cooperative strategies for problem solving arising from Nature could be discussed The contributions collected in this book were strictly peer reviewed by at least three members of the international programme committee to whom we are indebted for their support and assistance The topics covered by the contributions

include several well established nature inspired techniques like Genetic Algorithms Ant Colonies Artificial Immune Systems Evolutionary Robotics Evolvable Systems Membrane Computing Quantum Computing Software Self Assembly Swarm Intelligence etc     *Cycles of Contingency* Susan Oyama,Russell D. Gray,Paul E. Griffiths,2003-01-24 The nature nurture debate is not dead Dichotomous views of development still underlie many fundamental debates in the biological and social sciences Developmental systems theory DST offers a new conceptual framework with which to resolve such debates DST views ontogeny as contingent cycles of interaction among a varied set of developmental resources no one of which controls the process These factors include DNA cellular and organismic structure and social and ecological interactions DST has excited interest from a wide range of researchers from molecular biologists to anthropologists because of its ability to integrate evolutionary theory and other disciplines without falling into traditional oppositions The book provides historical background to DST recent theoretical findings on the mechanisms of heredity applications of the DST framework to behavioral development implications of DST for the philosophy of biology and critical reactions to DST     **Algorithm**

**Collections for Digital Signal Processing Applications Using Matlab** E.S. Gopi,2007-09-20 The Algorithms such as SVD Eigen decomposition Gaussian Mixture Model HMM etc are scattered in different fields There is the need to collect all such algorithms for quick reference Also there is the need to view such algorithms in application point of view Algorithm Collections for Digital Signal Processing Applications using MATLAB attempts to satisfy the above requirement Also the algorithms are made clear using MATLAB programs     **Nature Inspired Problem-Solving Methods in Knowledge**

**Engineering** José Mira,José R. Álvarez,2007-06-23 The second of a two volume set this book constitutes the refereed proceedings of the Second International Work Conference on the Interplay between Natural and Artificial Computation IWINAC 2007 held in La Manga del Mar Menor Spain in June 2007 It contains all the contributions connected with biologically inspired methods and techniques for solving AI and knowledge engineering problems in different application domains     **Clever Algorithms** Jason Brownlee,2011 This book provides a handbook of algorithmic recipes from the fields

of Metaheuristics Biologically Inspired Computation and Computational Intelligence that have been described in a complete consistent and centralized manner These standardized descriptions were carefully designed to be accessible usable and understandable Most of the algorithms described in this book were originally inspired by biological and natural systems such as the adaptive capabilities of genetic evolution and the acquired immune system and the foraging behaviors of birds bees ants and bacteria An encyclopedic algorithm reference this book is intended for research scientists engineers students and interested amateurs Each algorithm description provides a working code example in the Ruby Programming Language

**Advances in Swarm Intelligence** Ying Tan,KAY CHEN TAN,2010-06 The books LNCS 6145 and 6146 constitute the refereed proceedings of the International Conference on Swarm Intelligence ICSI 2010 held in Beijing China in June 2010 The 185 revised full papers presented were carefully reviewed and selected from 394 submissions The papers are organized in



topical sections on theoretical analysis of swarm intelligence algorithms PSO algorithms applications of PSO algorithms ACO algorithms applications of ACO algorithms artificial immune system novel swarm based optimization algorithms genetic algorithms evolutionary computation hybrid algorithms multi objective optimization algorithms multi robot systems multi agent based complex systems part I and fuzzy methods applications of computational intelligence algorithms signal processing and information security information processing system intelligent control classifier systems machine learning methods other optimization algorithms data mining methods intelligent computing methods and applications data mining algorithms and applications other applications part II

**Multi-Objective Optimization in Computer Networks Using Metaheuristics** Yezid Donoso, Ramon Fabregat, 2016-04-19 Metaheuristics are widely used to solve important practical combinatorial optimization problems Many new multicast applications emerging from the Internet such as TV over the Internet radio over the Internet and multipoint video streaming require reduced bandwidth consumption end to end delay and packet loss ratio It is necessary to design an

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