Ant Colony Optimization and Constraint Programming

Christine Solnon

Ant Colony Optimization And Constraint Programming

Leslie Pack Kaelbling

Ant Colony Optimization And Constraint Programming:

  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   Hybrid Metaheuristics Christian Blum,Luca Gaspero,Andrea Roli,Michael Sampels,Andrea Schaerf,2009-09-29 This book constitutes the refereed proceedings of the 6th International Workshop on Hybrid Metaheuristics HM 2009 held in Udine Italy in October 2009 The 12 revised full papers presented together with one invited talk were carefully reviewed and selected from 22 submissions The papers discuss current issues of combinations of metaheuristics and other solving techniques of universal concern such as novel combinations of components from different metaheuristics hybridization of metaheuristics and AI OR techniques low level hybridization high level hybridization portfolio techniques expert systems cooperative search automated parameter tuning empirical and statistical comparison theoretical aspects of hybridization parallelization and software libraries   Frontiers in AI and Computational Technologies Ahmed J. Obaid,Zdzisław Polkowski,Adriana Burlea-Schiopoiu,Muthmainnah Muthmainnah,2025-05-19 This book presents recent research on the application of Artificial Intelligence and Computational Technologies as discussed at the 2nd International Conference on Emerging Trends in AI and Computational Technologies The contributions in this volume highlight the advancements in AI fields and computational technologies such as machine learning generative intelligence and language based models and illustrate their transformative impact on their applications This proceeding comprising many techniques that focus on using AI in many fields such as Climate Change and Biodiversity Conservation Sustainability and Environmental Impact Education and Learning Techniques Smart City Planning and Management and Agriculture for Sustainable Food Production also introduces innovative methodologies and presents the findings derived from their original research Theoretical and empirical studies featured in this book employ a range of computational techniques including deep learning frameworks data driven analysis and optimization algorithms These approaches enhance the performance and efficiency of various applications in sectors like healthcare finance and entertainment Additionally the book explores the ethical

implications of deploying AI technologies and provides strategies to navigate the associated risks The chapters discuss essential topics such as methodology validation and the implications of AI in real world scenarios making this book a vital resource for understanding and leveraging the power of Artificial Intelligence and Computational Technologies in contemporary applications *Theory and Practice of Natural Computing* Adrian-Horia Dediu,Carlos Martín-Vide,Bianca Truthe,2012-09-26 This book constitutes the refereed proceedings of the First International Conference TPNC 2012 held in Tarragona Spain in October 2012 The 12 revised full papers presented together with 6 invited talks were carefully reviewed and selected from 34 submissions The papers are organized in topical sections on nature inspired models of computation synthesizing nature by means of computation nature inspired materials and information processing in nature *Artificial Intelligence: Methodology, Systems, and Applications* Jâerãome Euzenat,2006-09-11 This book constitutes the refereed proceedings of the 12th International Conference on Artificial Intelligence Methodology Systems and Applications AIMSA 2006 The 28 revised full papers presented together with the abstracts of 2 invited lectures were carefully reviewed and selected from 81 submissions The papers are organized in topical sections on agents constraints and optimization user concerns decision support models and ontologies machine learning ontology manipulation natural language processing and applications **MICAI 2006: Advances in Artificial Intelligence** Alexander Gelbukh,Carlos Alberto Reyes-Garcia,2006-11-07 This book constitutes the refereed proceedings of the 5th Mexican International Conference on Artificial Intelligence MICAI 2006 held in Apizaco Mexico in November 2006 It contains over 120 papers that address such topics as knowledge representation and reasoning machine learning and feature selection knowledge discovery computer vision image processing and image retrieval robotics as well as bioinformatics and medical applications Handbook of Metaheuristics Michel Gendreau,Jean-Yves Potvin,2018-09-20 The third edition of this handbook is designed to provide a broad coverage of the concepts implementations and applications in metaheuristics The book s chapters serve as stand alone presentations giving both the necessary underpinnings as well as practical guides for implementation The nature of metaheuristics invites an analyst to modify basic methods in response to problem characteristics past experiences and personal preferences and the chapters in this handbook are designed to facilitate this process as well This new edition has been fully revised and features new chapters on swarm intelligence and automated design of metaheuristics from flexible algorithm frameworks The authors who have contributed to this volume represent leading figures from the metaheuristic community and are responsible for pioneering contributions to the fields they write about Their collective work has significantly enriched the field of optimization in general and combinatorial optimization in particular Metaheuristics are solution methods that orchestrate an interaction between local improvement procedures and higher level strategies to create a process capable of escaping from local optima and performing a robust search of a solution space In addition many new and exciting developments and extensions have been observed in the last few years Hybrids of metaheuristics with other

optimization techniques like branch and bound mathematical programming or constraint programming are also increasingly popular On the front of applications metaheuristics are now used to find high quality solutions to an ever growing number of complex ill defined real world problems in particular combinatorial ones This handbook should continue to be a great reference for researchers graduate students as well as practitioners interested in metaheuristics **MEDINFO 2019: Health and Wellbeing e-Networks for All** Lucila Ohno-Machado,2019-11-15 Combining and integrating cross institutional data remains a challenge for both researchers and those involved in patient care Patient generated data can contribute precious information to healthcare professionals by enabling monitoring under normal life conditions and also helping patients play a more active role in their own care This book presents the proceedings of MEDINFO 2019 the 17th World Congress on Medical and Health Informatics held in Lyon France from 25 to 30 August 2019 The theme of this year s conference was Health and Wellbeing E Networks for All stressing the increasing importance of networks in healthcare on the one hand and the patient centered perspective on the other Over 1100 manuscripts were submitted to the conference and after a thorough review process by at least three reviewers and assessment by a scientific program committee member 285 papers and 296 posters were accepted together with 47 podium abstracts 7 demonstrations 45 panels 21 workshops and 9 tutorials All accepted paper and poster contributions are included in these proceedings The papers are grouped under four thematic tracks interpreting health and biomedical data supporting care delivery enabling precision medicine and public health and the human element in medical informatics The posters are divided into the same four groups The book presents an overview of state of the art informatics projects from multiple regions of the world it will be of interest to anyone working in the field of medical informatics *Constraint-based Local Search* Pascal Van Hentenryck,Laurent Michel,2005 The ubiquity of combinatorial optimization problems in our society is illustrated by the novel application areas for optimization technology which range from supply chain management to sports tournament scheduling Over the last two decades constraint programming has emerged as a fundamental methodology to solve a variety of combinatorial problems and rich constraint programming languages have been developed for expressing and combining constraints and specifying search procedures at a high level of abstraction Local search approaches to combinatorial optimization are able to isolate optimal or near optimal solutions within reasonable time constraints This book introduces a method for solving combinatorial optimization problems that combines constraint programming and local search using constraints to describe and control local search and a programming language COMET that supports both modeling and search abstractions in the spirit of constraint programming After an overview of local search including neighborhoods heuristics and metaheuristics the book presents the architecture and modeling and search components of constraint based local search and describes how constraint based local search is supported in COMET The book describes a variety of applications arranged by meta heuristics It presents scheduling applications along with the background necessary to understand these challenging problems The book also

includes a number of satisfiability problems illustrating the ability of constraint based local search approaches to cope with both satisfiability and optimization problems in a uniform fashion   *Principles and Practice of Constraint Programming* ,2004   Sequencing and Sorting in Just-In-Time Production Robert Nickel,2005-04-07 Diploma Thesis from the year 2004 in the subject Mathematics Applied Mathematics grade 1 3 Brandenburg Technical University Cottbus Institut f r Mathematik language English abstract Since Karl Benz built the first motor driven vehicle in 1886 a new industry was born which is still one of the most important and influential sectors of economy His 0 9 horse power engine only reached 15 kilometers per hour but gave the starting shot for more and more inventions and a rapidly growing automobile industry First cars where used for racing only but during the first period of the twentieth century it established its position as a new and individual means of transport In 1936 the first Volkswagen called Beetle a vehicle for the masses was developed by Ferdinand Porsche and has been produced for 67 years The last Beetle was built in the summer of 2003 in Mexico Worldwide 100 000 new cars are being produced every day and in 2010 there will be over 1 billion private cars all over the world This development requires perfectly organized and well optimized production processes and still calls for new inventions and improvements The production process in automobile manufacturing splits into three major stages The moulding and welding of the car body in the body shop the painting of the welded car bodies in the paint shop and the customization of the painted car bodies in the assembly shop The work presented here deals with the last two stages The production plant contains a system of production lines which sometimes split into parallel lines and reunite to a non parallel line Each of these lines can require some set of restrictions on the cars sequenced on that line In the paint shop the cars are being painted on a line by a robot which through jets sprays the color onto the surface of the car body Whenever the next car on the line has the same color the jets can be re used Otherwise they have to be cleaned which requires time and causes pollution Therefore minimizing the color changes that occur in the paint shop can save non negligible costs In the assembly shop separate teams install different options into the cars such as sun roof air conditioning central locking system etc Therefore the order of the cars on the line has to fulfill some restrictions considering that each option requires a fixed time for installation and resources which have to be available at the time of installation   *Stochastic Algorithms* ,2001   *Hybrids of Stochastic Metaheuristics and Constraint Programming for Combinatorial Optimization* Dhananjay Raghavan Thiruvady,2012 Combinatorial optimization problems are frequently encountered in scientific and industrial applications A large number of these problems are known to be NP hard and solving these problems by exact complete methods is often impractical Therefore heuristic methods are often the best way to deal with such problems However when these problems additionally include hard constraints heuristic metaheuristic methods often fail and perform poorly A solution to this is to integrate these methods with techniques like constraint programming CP where constraints maybe easily specified and efficiently dealt with thereby providing effective solutions to combinatorial optimization problems with non trivial hard constraints This thesis specifically investigates the

integration of stochastic metaheuristics and constraint programming for combinatorial optimization problems COPs with non trivial hard constraints Among stochastic metaheuristics we consider ant colony optimization ACO and beam search The base algorithm we begin with is the hybrid CP ACO Meyer and Ernst 2004 and the aim of the thesis is to show that this algorithm can be made efficient by parallelizing the solution construction of ACO dependent solution construction as opposed to solution construction onmultiple machines cores via beam search leading to the hybrid CP Beam ACO We consider three case studies to demonstrate the effectiveness of the new hybrid The first problem is single machine job scheduling with sequence dependent setup times SMJS The aim here is to minimize makespan making sure hard release and due time constraints are not violated Secondly a resource constrained multiple machine job scheduled MMJS problem is tackled Here constraints include release times due times precedences and a resource constraint across the machines The aim is to minimize the total weighted tardiness of the scheduled jobs The last problem considered is the car sequencing CS problem Here a number of cars requiring options must be sequenced such that sub sequences of a particular length may only allow a specific number of each option We investigate the performance of our algorithms on the optimization version which further requires the utilization of options be effectively modulated across the sub sequences By applying ACO Beam ACO CP ACO and CP Beam ACO to the above problems we see that CP ACO methods are by far the best performing algorithms in terms of solution quality This is clearly seen on the SMJS and CS problems for which complex CP models have been defined There is a slight disadvantage to CP ACO for the MMJS problem where the CP model is relatively simple In termsof finding feasible solutions the feasibility advantages of CP ACO are inherited by CP Beam ACO We also see for the MMJS problem that CP Beam ACO has a significant advantage in this respect In conclusion this thesis demonstrates that constraint based ACO is an efficient and effective method to tackle real world COPs In particular CP ACO can be made efficient by parallelizing the solution construction of the ACO component resulting in CP Beam ACO The new algorithm provides significant advantages for three different types of real world COPs with non trivial hard constraints and can be viewed as the practically viable option for implementing ACO with CP   Mathematical Reviews ,2007   *Meta-heuristics* Ulrich Derigs,2004   **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

IJCAI-05 Leslie Pack Kaelbling,2005   RAIRO. ,2005 International journal devoted to pure and applied research on the use of scientific methods and information processing in business and industry Articles may be in English or French   *A Study Into Ant Colony Optimisation, Evolutionary Computation and Constraint Programming on Binary Constraint Satisfaction Problems* Jano Iljà van Hemert,Christine Solnon,2004   **Logic Programming and Non-monotonic Reasoning** ,2001

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