Solving Job Shop Scheduling Problem Using An Ant Colony

Besides scheduling problems for single and parallel machines and shop scheduling problems, the book covers advanced models involving due-dates, sequence dependent change-over times and batching. A discussion of multiprocessor task scheduling and problems with multi-purpose machines is accompanied by the methods used to solve such problems, such as polynomial algorithms, dynamic programming procedures, branch-and-bound algorithms and local search heuristics, and the whole is rounded off with an analysis of complexity issues.

This proceedings contains the papers presented at the 2004 IFIP International Conference on Network and Parallel Computing (NPC 2004), held at Wuhan, China, from October 18 to 20, 2004. The goal of the conference was to establish an international forum for engineers and scientists to present their ideas and experiences in network and parallel computing. A total of 338 submissions were received in response to the call for papers. These papers werefrom Australia, Brazil,Canada,China, Finland, France, G- many, Hong Kong, India, Iran, Italy, Japan, Korea, Luxemburg, Malaysia, N- way, Spain, Sweden, Taiwan, UK, and USA. Each submission was sent to at least three reviewers. Each paper was judged according to its originality, inno- tion, readability, and relevance to the expected audience. Based on the reviews received, a total of 69 papers were accepted to be included in the proceedings. Among the 69 papers, 46 were accepted as full papers and were presented at the conference. We also accepted 23 papers as short papers; each of these papers was given an opportunity to have a brief presentation at the conference, followed by discussions in a poster session. Thus, due to the limited scope and time of the conference and the high number of submissions received, only 20% of the total submissions were included in the final program. This book constitutes the thoroughly refereed post-conference proceedings of the 12th International Conference on Learning and Intelligent Optimization, LION 12, held in Kalamata, Greece, in June 2018. The 28 full papers and 12 short papers presented have been carefully reviewed and selected from 62 submissions. The papers explore the advanced research developments in such interconnected fields as mathematical programming, global optimization, machine learning, and artificial intelligence. Special focus is given to advanced ideas, technologies, methods, and applications in optimization and machine learning.

Mathematical Aspects of Scheduling and Applications addresses the perennial problem of optimal utilization of finite resources in the accomplishment of an assortment of tasks or objectives. The book provides ways to uncover the core of these problems, presents them in mathematical terms, and devises mathematical solutions for them. The book consists of 12 chapters. Chapter 1 deals with network problems, the shortest path problem, and applications to control theory. Chapter 2 stresses the role and use of computers based on the decision-making problems outlined in the preceding chapter. Chapter 3 classifies scheduling problems and their solution approaches. Chapters 4 to 6 discuss machine sequencing problems and techniques. Chapter 5 tackles capacity expansion problems and introduces the technique of embedded state space dynamic programming for reducing dimensionality so that larger problems can be solved. Chapter 6 then examines an important class of network problems with non-serial phase structures and exploits dimensionality reduction techniques, such as the pseudo-stage concept, branch compression, and optimal order elimination methods to solve large-scale, nonlinear network scheduling problems. Chapters 7 to 11 consider the flow-shop scheduling problem under different objectives and constraints. Chapter 12 discusses the job-shop-scheduling problem. The book will be useful to economists, planners, and graduate students in the fields of mathematics, operations research, management science, computer science, and engineering.

The evolution of soft computing applications has offered a multitude of methodologies and techniques that are useful in facilitating new ways to address practical and real scenarios in a variety of fields. In particular, these concepts have created significant developments in the engineering field. Soft Computing Techniques and Applications in Mechanical Engineering is a pivotal reference source for the latest research findings on a comprehensive range of soft computing techniques applied in various fields of mechanical engineering. Featuring extensive coverage on relevant areas such as thermodynamics, fuzzy computing, and computational intelligence, this publication is an ideal resource for students, engineers, research scientists, and academicians involved in soft computing techniques and applications in mechanical engineering areas.

This book presents the latest findings on one of the most intensely investigated subjects in computational mathematics--the traveling salesman problem. It sounds simple enough: given a set of cities and the cost of travel between each pair of them, the problem challenges you to find the cheapest route by which to visit all the cities and return home to where you began. Though seemingly modest, this exercise has inspired studies by mathematicians, chemists, and physicists. Teachers use it in the classroom. It has practical applications in genetics, telecommunications, and neuroscience. The authors of this book are the same pioneers who for nearly two decades have led the investigation into the traveling salesman problem. They have derived solutions to almost eighty-six thousand cities, yet a general solution to the problem has yet to be discovered. Here they describe the method and computer code they used to solve a broad range of large-scale problems, and along the way they demonstrate the interplay of applied mathematics with increasingly powerful computing platforms. They also give the fascinating history of the problem--how it developed, and why it continues to intrigue us.

Multiobjective Scheduling by Genetic Algorithms describes methods for developing multiobjective solutions to common production scheduling equations modeling in the literature as flowshops, job shops and open shops. The methodology is metaheuristic, one inspired by how nature has evolved a multitude of coexisting species of living beings on earth. Multiobjective flowshops, job shops and open shops are each highly relevant models in manufacturing, classroom scheduling or automotive assembly, yet for want of sound
methods they have remained almost untouched to date. This text shows how methods such as Elitist Nondominated Sorting Genetic Algorithm (ENGA) can find a bevy of Pareto optimal solutions for them. Also it accents the value of hybridizing Gas with both solution-generating and solution-improvement methods. It envisions fundamental research into such methods, greatly strengthening the growing reach of metaheuristic methods. This book is therefore intended for students of industrial engineering, operations research, operations management and computer science, as well as practitioners. It may also assist in the development of efficient shop management software tools for schedulers and production planners who face multiple planning and operating objectives as a matter of course.

This book constitutes the thoroughly refereed post-conference proceedings of the 9th International Conference on Learning and Intelligent Optimization, LION 9, held in Rome, Italy, in January 2011. The 36 revised regular and 3 revised short papers were carefully reviewed and selected from a total of 99 submissions. In addition to the contributions to the general track there are 11 full papers and 3 short papers presented at the following four special sessions: IMON: Intelligent Multiobjective Optimization; LION-PP: Performance Prediction Self-tuning, self-configuring and self-generating evolutionary algorithms; LION-SWAP: Software and Applications.

The first comprehensive book to uniquely combine the three fields of systems engineering, operations/production systems, and multiple criteria decision making/optimization. Systems engineering is the art and science of designing, engineering, and building complex systems—combining art, science, management, and engineering disciplines. Operations and Production Systems with Multiple Objectives covers all classical topics of operations and production systems as well as new topics not seen in any similar textbooks before: small-scale design of cellular systems, large-scale design of complex systems, clustering, productivity and efficiency measurements, and energy systems. Filled with completely new perspectives, paradigms, and robust methods of solving classic and modern problems, the book includes numerous examples and sample spreadsheets for solving each problem, a solutions manual, and a book companion site complete with worked examples and supplemental articles. Operations and Production Systems with Multiple Objectives will teach readers: How operations and production systems are designed and planned. How operations and production systems are engineered and optimized. How to formulate and solve manufacturing systems problems. How to model and solve interdisciplinary and systems engineering problems. How to solve decision problems with multiple and conflicting objectives. This book is ideal for senior undergraduate, MS, and PhD graduate students in all fields of engineering, business, and management as well as practitioners and researchers in systems engineering, operations, production, and manufacturing.

This book constitutes the refereed proceedings of the 8th Annual European Symposium on Algorithms, ESA 2000, held in Saarbrücken, Germany in September 2000. The 39 revised full papers presented together with two invited papers were carefully reviewed and selected for inclusion in the book. Among the topics addressed are parallelism, distributed systems, approximation, combinatorial optimization, computational biology, computational geometry, external-memory algorithms, graph algorithms, network algorithms, online algorithms, data compression, symbolic computation, pattern matching, and randomized algorithms.

Jens Kuhpfahl analyzes the job shop scheduling problem with minimizing the total weighted tardiness as objective. First, he provides a suitable graph representation based on a disjunctive graph formulation. Second, several key components of local search procedures are analyzed and enhanced. The resulting outputs of these investigations contribute to the development of a new solution procedure whose performance quality leads to superior computational results.

Scheduling, planning and packing are ubiquitous problems that can be found in a wide range of real-world settings. These problems transpire in a large variety of forms, and have enormous socio-economic impact. For many years, significant work has been devoted to automating the processes of scheduling, planning and packing using different kinds of methods. However, poor scaling and the lack of flexibility of many of the conventional methods coupled with the fact that most of the real-world problems across the application areas of scheduling, planning and packing nowadays tend to be of large scale, dynamic and full of complex dependencies have made it necessary to tackle them in unconventional ways. This volume, "Natural Intelligence for Scheduling, Planning and Packing Problems", is a collection of numerous natural intelligence based approaches for solving various kinds of scheduling, planning and packing problems. It comprises 12 chapters which present many methods that draw inspiration from nature, such as evolutionary algorithms, neural-fuzzy system, particle swarm algorithms, ant colony optimisation, extremal optimisation, raindrop optimisation, and so on. Problems addressed by these chapters include freight transportation, job shop scheduling, flowshop scheduling, electrical load forecasting, vehicle routing, two-dimensional strip packing, network configuration and forest planning, among others. Along with solving these problems, the contributing authors present a lively discussion of the various aspects of the nature-inspired algorithms utilised, providing very useful and important new insights into the research areas.

Meta-heuristics have developed dramatically since their inception in the early 1980s. They have had widespread success in attacking a variety of practical and difficult combinatorial optimization problems. These families of approaches include, but are not limited to greedy random adaptive search procedures, genetic algorithms, problem-space search, neural networks, simulated annealing, tabu search, threshold algorithms, and their hybrids. They incorporate concepts based on biological evolution, intelligent problem solving, mathematical and physical sciences, nervous systems, and statistical mechanics. Since the 1980s, a great deal of effort has been invested in the field of combinatorial optimization theory in which heuristic algorithms have become an important area of research and applications. This volume is drawn from the first conference on Meta-Heuristics and contains 41 papers on the state-of-the-art in heuristic theory and applications. The book treats the following meta-heuristics and applications: Genetic Algorithms, Simulated Annealing, Tabu Search, Networks & Graphs, Scheduling and Control, TSP, and Vehicle Routing Problems. It represents research from the fields of Operations Research,
Management Science, Artificial Intelligence and Computer Science.
The seven-volume set LNCS 12137, 12138, 12139, 12140, 12141, 12142, and 12143 constitutes the proceedings of the 20th International Conference on Computational Science, ICCS 2020, held in Amsterdam, The Netherlands, in June 2020.* The total of 101 papers and 248 workshop papers presented in this book set were carefully reviewed and selected from 719 submissions (230 submissions to the main track and 489 submissions to the workshops). The papers were organized in topical sections named: Part I: ICCS Main Track Part II: ICCS Main Track Part III: Advances in High-Performance Computational Earth Sciences: Applications and Frameworks; Agent-Based Simulations, Adaptive Algorithms and Solvers; Applications of Computational Methods in Artificial Intelligence and Machine Learning; Biomedical and Bioinformatics Challenges for Computer Science Part IV: Classifier Learning from Difficult Data; Complex Social Systems through the Lens of Computational Science; Computational Health; Computational Methods for Emerging Problems in (Dis-)Information Analysis Part V: Computational Optimization, Modelling and Simulation; Computational Science in IoT and Smart Systems; Computer Graphics, Image Processing and Artificial Intelligence Part VI: Data Driven Computational Sciences; Machine Learning and Data Assimilation for Dynamical Systems; Meshfree Methods in Computational Sciences; Multiscale Modelling and Simulation; Quantum Computing Workshop Part VII: Simulations of Flow and Transport: Modeling, Algorithms and Computation; Smart Systems: Bringing Together Computer Vision, Sensor Networks and Machine Learning; Software Engineering for Computational Science; Solving Problems with Uncertainties; Teaching Computational Science; UNcErtnaty QUantificatiOn for ComputationAI modeLs.* The conference was canceled due to the COVID-19 pandemic. Presents current developments in the field of evolutionary scheduling and demonstrates the applicability of evolutionary computational techniques to solving scheduling problems. This book provides insight into the use of evolutionary computations (EC) in real-world scheduling, showing readers how to choose a specific evolutionary computation and how to validate the results using metrics and statistics. It offers a spectrum of real-world optimization problems, including applications of EC in industry and service organizations such as healthcare scheduling, aircraft industry, school timetabling, manufacturing systems, and transportation scheduling in the supply chain. It also features problems with different degrees of complexity, practical requirements, user constraints, and MOEC solution approaches. Evolutionary Computation in Scheduling starts with a chapter on scientometric analysis to analyze scientific literature in evolutionary computation in scheduling. It then examines the role and impacts of ant colony optimization (ACO) in job shop scheduling problems, before presenting the application of the ACO algorithm in healthcare scheduling. Other chapters explore task scheduling in heterogeneous computing systems and truck scheduling using swarm intelligence, application of sub-population scheduling algorithm in multi-population evolutionary dynamic optimization, task scheduling in cloud environments, scheduling of robotic disassembly in remanufacturing using the bees algorithm, and more. This book: Provides a representative sampling of real-world problems currently being tackled by practitioners Examines a variety of single-, multi-, and many-objective problems that have been solved using evolutionary computations, including evolutionary algorithms and swarm intelligence Consists of four main parts: Introduction to Scheduling Problems, Computational Issues in Scheduling Problems, Evolutionary Computation, and Computational Algorithms for Scheduling Problems Evolutionary Computation in Scheduling is ideal for engineers in industries, research scholars, advanced undergraduates and graduate students, and faculty teaching and conducting research in Operations Research and Industrial Engineering.

This volume constitutes the proceedings of the Third Annual ACM-SIAM Symposium on Discrete Algorithms, held in Orlando, Florida, in January 1992.

This book offers fourteen select papers presented at the recent Asia-Pacific Symposia on Intelligent and Evolutionary Systems. They illustrate the breadth of research in the field with applications ranging from business to medicine to network optimization. Finding exact solutions to many combinatorial optimization problems in business, engineering, and science still poses a real challenge, despite the impact of recent advances in mathematical programming and computer technology. New fields of applications, such as computational biology, electronic commerce, and supply chain management, bring new challenges and needs for algorithms and optimization techniques. Metaheuristics are master procedures that guide and modify the operations of subordinate heuristics, to produce improved approximate solutions to hard optimization problems with respect to more simple algorithms. They also provide fast and robust tools, producing high-quality solutions in reasonable computation times. The field of metaheuristics has been fast evolving in recent years. Techniques such as simulated annealing, tabu search, genetic algorithms, scatter search, greedy randomized adaptive search, variable neighborhood search, ant systems, and their hybrids are currently among the most efficient and robust optimization strategies to find high-quality solutions to many real-life optimization problems. A very large number of successful applications of metaheuristics are reported in the literature and spread throughout many books, journals, and conference proceedings. A series of international conferences entirely devoted to the theory, applications, and computational developments in metaheuristics has been attracting an increasing number of participants, from universities and the industry.
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This three volume set (CCIS 1237-1239) constitutes the proceedings of the 18th International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, IPMU 2020, in June 2020. The conference was scheduled to take place in Lisbon, Portugal, at University of Lisbon, but due to COVID-19 pandemic it was held virtually. The 173 papers were carefully reviewed and selected from 213 submissions. The papers are organized in topical sections: homage to Enrique Ruspini; invited talks; foundations and mathematics; decision making, preferences and votes; optimization and uncertainty; games; real world applications; knowledge processing and creation; machine learning I; machine learning II; XAI; image processing; temporal data processing; text analysis and processing; fuzzy interval analysis; theoretical and applied aspects of imprecise probabilities; similarities in artificial intelligence; belief function theory and its applications; aggregation: theory and practice; aggregation: pre-aggregation functions and other generalizations of monotonicity; aggregation: aggregation of different data structures; fuzzy methods in data mining and knowledge discovery; computational intelligence for logistics and transportation problems; fuzzy implication functions; soft methods in statistics and data analysis; image understanding and explainable AI; fuzzy and generalized quantifier theory; mathematical methods towards dealing with uncertainty in applied sciences; statistical image processing and analysis, with applications in neuroimaging; interval uncertainty; discrete models and computational intelligence; current techniques to model, process and describe time series; mathematical fuzzy logic and graded reasoning models; formal concept analysis, rough sets, general operators and related topics; computational intelligence methods in information modelling, representation and processing.

This book presents models and algorithms for complex scheduling problems. Besides resource-constrained project scheduling problems with applications also job-shop problems with flexible machines, transportation or limited buffers are discussed. Discrete optimization methods like linear and integer programming, constraint propagation techniques, shortest path and network flow algorithms, branch-and-bound methods, local search and genetic algorithms, and dynamic programming are presented. They are used in exact or heuristic procedures to solve the introduced complex scheduling problems. Furthermore, methods for calculating lower bounds are described. Most algorithms are formulated in detail and illustrated with examples. In this second edition some errors were corrected, some parts were explained in more detail, and new material has been added. In particular, further generalizations of the RCPSP, additional practical applications and some more algorithms were integrated.

The main goal of this book is to provide a state of the art of hybrid metaheuristics. The book provides a complete background that enables readers to design and implement hybrid metaheuristics to solve complex optimization problems (continuous/discrete, mono-objective/multi-objective, optimization under uncertainty) in a diverse range of application domains. Readers learn to solve large scale problems quickly and efficiently combining metaheuristics with complementary metaheuristics, mathematical programming, constraint programming and machine learning. Numerous real-world examples of problems and solutions demonstrate how hybrid metaheuristics are applied in such fields as networks, logistics and transportation, bio-medical, engineering design, scheduling.

This book is a printed edition of the Special Issue "Algorithms for Scheduling Problems" that was published in Algorithms
This book provides a theoretical and application-oriented analysis of deterministic scheduling problems in advanced planning and computer systems. The text examines scheduling problems across a range of parameters: job priority, release times, due dates, processing times, precedence constraints, resource usage and more, focusing on such topics as computer systems and supply chain management. Discussion includes single and parallel processors, flexible shops and manufacturing systems, and resource-constrained project scheduling. Many applications from industry and service operations management and case studies are described. The handbook will be useful to a broad audience, from researchers to practitioners, graduate and advanced undergraduate students.

The Intelligent Systems Series comprises titles that present state of the art knowledge and the latest advances in intelligent systems. Its scope includes theoretical studies, design methods, and real-world implementations and applications. Service Science, Management, and Engineering presents the latest issues and development in service science. Both theory and applications issues are covered in this book, which integrates a variety of disciplines, including engineering, management, and information systems. These topics are each related to service science from various perspectives, and the book is supported throughout by applications and case studies that showcase best practice and provide insight and guidelines to assist in building successful service systems. Presents the latest research on service science, management and engineering, from both theory and applications perspectives. Includes coverage of applications in high-growth sectors, along with real-world frameworks and design techniques. Applications and case studies showcase best practices and provide insights and guidelines to those building and managing service systems.
The book covers different aspects of real-world applications of optimization algorithms. It provides insights from the Fourth International Conference on Harmony Search, Soft Computing and Applications held at BML Munjal University, Gurgaon, India on February 7–9, 2018. It consists of research articles on novel and newly proposed optimization algorithms; the theoretical study of nature-inspired optimization algorithms; numerically established results of nature-inspired optimization algorithms; and real-world applications of optimization algorithms and synthetic benchmarking of optimization algorithms.

This book constitutes the refereed proceedings of the 5th International Workshop on Ant Colony Optimization and Swarm Intelligence, ANTS 2006, held in Brussels, Belgium, in September 2006. The 27 revised full papers, 23 revised short papers, and 12 extended abstracts presented were carefully reviewed and selected from 115 submissions. This book describes the potentialities of metaheuristics for solving production scheduling problems and the relationship between these two fields. For the past several years, there has been an increasing interest in using metaheuristic methods to solve scheduling problems. The main reasons for this are that such problems are generally hard to solve to optimality, as well as the fact that metaheuristics provide very good solutions in a reasonable time. The first part of the book presents eight applications of metaheuristics for solving various mono-objective scheduling problems. The second part is itself split into two, the first section being devoted to five multi-objective problems to which metaheuristics are adapted, while the second tackles various transportation problems related to the organization of production systems. Many real-world applications are presented by the authors, making this an invaluable resource for researchers and students in engineering, economics, mathematics and computer science.


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