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Arc Routing Problems with Time-dependent Service Costs

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Arc Routing Springer
In a unified and carefully developed presentation, this book systematically examines recent developments in VRP. The book focuses on a portfolio of significant technical advances that have evolved over the past few years for modeling and solving vehicle routing problems and VRP variations. Reflecting the most recent scholarship, this book is written by one of the top research scholars in Vehicle Routing and is one of the most important books in VRP to be published in

recent times.

Exact and Heuristic Approaches to Arc Routing Problems

Springer Science & Business Media

This paper studies the arc-routing problem that arises in small-package delivery. In practice, each service provider is encouraged to follow a master route -- a predesigned sequence of street addresses -- over an extended planning horizon (more than one day). The objective here is to construct efficient master routes. The focus on arc routing offers two advantages. First, real-world vehicle routing takes place over a street network, rather than in Euclidean space. Second, there

are, typically, many fewer streets than customer locations. Currently, a deterministic arc-routing problem (DARP) model is used to solve the problem. However, this approach ignores the uncertainty in the street segment presence probability -- the probability that a street segment requires (i.e., there is a demand for) a visit on a particular day. We introduce two new models, namely, the probabilistic arc-routing problem (PARP) model and the multiday arc-routing problem (MARP) model, which take into account the street segment presence probabilities. PARP attempts to minimize the expected length of the master route. It

assumes that the street segment presence probabilities are independent. This model can require excessive amounts of computation time. On the other hand, MARP tries to minimize average length of the master route over prespecified days. This model can also be viewed as a Monte Carlo simulation approximation of the PARP. This approximation significantly reduces the computational burden. Additionally, by utilizing historical data, MARP incorporates real-world correlations among the street segment presence probabilities. Our computational results show that PARP and MARP may produce more efficient master routes than

DARP by taking demand uncertainty into account.

Application of Heuristics and Metaheuristics to the Capacitated Arc

Routing Problem John Wiley & Sons

Arc Routing: Theory, Solutions and

Applications is about arc traversal and the

wide variety of arc routing problems,

which has had its foundations in the

modern graph theory work of Leonhard

Euler. Arc routing methods and

computation has become a fundamental

optimization concept in operations research

and has numerous applications in

transportation, telecommunications,

manufacturing, the Internet, and many

other areas of modern

life. The book draws from a variety of sources including the traveling salesman problem (TSP) and graph theory, which are used and studied by operations research, engineers, computer scientists, and mathematicians. In the last ten years or so, there has been extensive coverage of arc routing problems in the research literature, especially from a graph theory perspective; however, the field has not had the benefit of a uniform, systematic treatment. With this book, there is now a single volume that focuses on state-of-the-art exposition of arc routing problems, that explores its graph theoretical foundations, and that presents a number of solution methodologies

in a variety of application settings. Moshe Dror has succeeded in working with an elite group of ARC routing scholars to develop the highest quality treatment of the current state-of-the-art in arc routing.

Arc Routing Problems for Road Network

Maintenance Springer Science & Business Media

This book presents state-of-the-art research and practice in optimization routing, specifically the vehicle routing problem (VRP). Since its introduction in the late 1950s, the VRP has been a very significant area of research and practice in operations research. Vehicles are used to make deliveries and for pick-ups every day and everywhere.

Companies such as Amazon, UPS, FedEx, and DHL use route optimization to reduce mileage, fuel use, number of trucks on the road, and carbon dioxide emissions. The authors compile and analyze 135 survey and review articles on vehicle routing topics published between 2005 and 2022 in an effort to make key observations about publication and trend history, summarize the overall contributions in the field, and identify trends in VRP research and practice. The authors have compiled published research on models, algorithms, and applications for specific areas, including: alternative and multiple objectives; arc routing and general routing; drones, last-mile

delivery, and urban distribution; dynamic and stochastic routing; green routing; inventory routing; loading constraints; location-routing; multiple depots; pickup and delivery and dial-a-ride problems; rich and multi-attribute routing; routing over time; shipping; two-echelon, collaborative, and inter-terminal problems; specific variants, benchmark datasets, and software; and exact algorithms and heuristics. In addition, the book discusses how vehicle routing problems are among the most widely studied problems in combinatorial optimization due to the mathematical complexity and practical significance. Location Science SIAM

The purpose of this

thesis is to study arc routing problems and design metaheuristic methods in order to provide high quality solutions to existing problems, focusing on the Capacitated Arc Routing Problem. The first part of the thesis will contain a literature study on vehicle routing problems and the existing methodology used to solve them. In the practical part, first a simple greedy algorithm is going to be used to get some starting results. Afterwards, the objective will be designing and implementing heuristics and metaheuristics in search of the better solutions. The results are going to be analysed and compared between

them and also with other methods that already exist in the literature.

Bio-inspired Algorithms for the Vehicle Routing Problem Springer Science & Business Media

This tutorial introduces readers to several variants of routing problems with profits. In these routing problems each node has a certain profit, and not all nodes need to be visited. Since the orienteering problem (OP) is by far the most frequently studied problem in this category of routing problems, the book mainly focuses on the OP. In turn, other problems are presented as variants of the OP, focusing on the similarities and differences. The goal of the OP is to determine

a subset of nodes to visit and in which order, so that the total collected profit is maximized and a given time budget is not exceeded. The book provides a comprehensive review of variants of the OP, such as the team OP, the team OP with time windows, the profitable tour problem, and the prize-collecting travelling salesperson problem. In addition, it presents mathematical models and techniques for solving these OP variants and discusses their complexity. Several simple examples and benchmark instances, together with their best-known results, are also included. Finally, the book reviews the latest applications of these problems in the fields of logistics,

tourism and others.
A Column Generation Procedure for Solving the Capacitated Arc Routing Problem

Springer

The vehicle routing problem (VRP) is one of the most famous combinatorial optimization problems. In simple terms, the goal is to determine a set of routes with overall minimum cost that can satisfy several geographical scattered - mands. A fleet of vehicles located in one or more depots is available to fulfill the requests. A large number of variants exist, adding different constraints to the original definition. Some examples are related to the number of depots, the ordering for visiting the customers or to time windows specifying a

desirable period to arrive to a given location. The original version of this problem was proposed by Dantzig and Ramser in 1959 [1]. In their seminal paper, the authors address the calculation of a set of optimal routes for a fleet of gasoline delivery trucks. Since then, the VRP has attracted the attention of a large number of researchers. A considerable part of its success is a consequence of its practical interest, as it resembles many real-world problems faced everyday by distribution and transportation companies, just to mention a few applications areas. In this context, the development of efficient optimization techniques is crucial.

They are able to provide new and enhanced solutionstologisticoperations, and may therefore lead to a substantial reduction in costs for companies.

Additionally, and from a research oriented perspective, the VRP is a challenging NP-hard problem providing excellent benchmarks to access the efficiency of new global optimization algorithms.

Ant Colony Optimization

Montréal : Groupe d'études et de recherche en analyse des décisions
 Vehicle routing problems, among the most studied in combinatorial optimization, arise in many practical contexts (freight distribution and

collection, transportation, garbage collection, newspaper delivery, etc.). Operations researchers have made significant developments in the algorithms for their solution, and *Vehicle Routing: Problems, Methods, and Applications, Second Edition* reflects these advances. The text of the new edition is either completely new or significantly revised and provides extensive and complete state-of-the-art coverage of vehicle routing by those who have done most of the innovative research in the area; it emphasizes methodology related to specific classes of vehicle routing problems and, since vehicle routing is used as a benchmark for all

new solution techniques, contains a complete overview of current solutions to combinatorial optimization problems. It also includes several chapters on important and emerging applications, such as disaster relief and green vehicle routing.

Scatter Search

Montréal : Centre for Research on Transportation = Centre de recherche sur les transports (C.R.T.)

This book constitutes the refereed proceedings of the 8th International Conference on Computational Logistics, ICCL 2017, held in Southampton, UK, in October 2017. The 38 papers presented in this volume were carefully reviewed and selected for inclusion in

the book. They are organized in topical sections entitled: vehicle routing and scheduling; maritime logistics; synchromodal transportation; and transportation, logistics and supply chain planning.

Solving the Close-enough Arc Routing Problem John Wiley & Sons

Arc routing problems arise in several areas of distribution management and have long been the object of study of mathematicians and operations researchers. This second part of a two-part survey reviews the main algorithms on the Rural Postman problem (RPP), including applications, the undirected RPP, the directed RPP, the stacker crane problem,

and the capacitated arc routing problem.

Parallel Insert Method for the Capacitated Arc Routing Problem

Springer Nature

This book provides a thorough and up-to-date discussion of arc routing by world-renowned researchers. Organized by problem type, the book offers a rigorous treatment of complexity issues, models, algorithms, and applications. Arc Routing: Problems, Methods, and Applications opens with a historical perspective of the field and is followed by three sections that cover complexity and the Chinese Postman and the Rural Postman problems; the Capacitated Arc Routing Problem and routing problems with

min-max and profit maximization objectives; and important applications, including meter reading, snow removal, and waste collection.

A Time Buffered Arc Routing Problem

Springer

Solving Transport Problems establishes fundamental points and good practice in resolving matters regarding green transportation. This is to prompt further research in conveyance issues by providing readers with new knowledge and grounds for integrated models and solution methods. Focusing on green transportation, this book covers various sub-topics and thus consists of diverse content. Traditionally, academia and transport practitioners

have mainly concentrated on efficient fleet management to achieve economic benefits and better-quality service. More recently, due to growing public environmental concerns and the industry understanding of the issue, the academic community has started to address environmental issues. The studies of green transportation compiled in this book have identified certain areas of interest, such as references, viewpoints, algorithms and ideas. Solving Transport Problems is for researchers, environmental decision-makers and other concerned parties, to start discussion on developing optimized

technology and alternative fuel-based integrated models for environmentally cleaner transport systems.

The Vehicle Routing Problem: Latest Advances and New Challenges Springer Nature

The scopes of this study are as follows; the limitation for data collection is based on small town in Perlis residential area around Arau, Kangar and Kuala Perlis; the existing heuristics are used to solve the problem within the limit of MCARP models; the limitation of the vehicle capacity in range 5000 kilogram until 10000 kilogram based on the vehicle capacity used in Perlis state.

Vehicle Routing SIAM
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.

Solving Transport Problems Montréal : Centre for Research on Transportation = Centre de recherche sur les transports

The book Scatter Search by Manuel Laguna and Rafael Martí represents a long-awaited "missing link" in the literature of evolutionary methods. Scatter Search (SS)-together with its generalized form called Path Relinking-constitutes the only evolutionary approach that embraces a collection of principles from Tabu Search (TS), an approach popularly regarded to be divorced from evolutionary procedures. The TS perspective, which is responsible for introducing adaptive memory strategies into the metaheuristic literature (at purposeful level beyond simple inheritance mechanisms), may at first seem to be at

odds with population-based approaches. Yet this perspective equips SS with a remarkably effective foundation for solving a wide range of practical problems. The successes documented by Scatter Search come not so much from the adoption of adaptive memory in the range of ways proposed in Tabu Search (except where, as often happens, SS is advantageously coupled with TS), but from the use of strategic ideas initially proposed for exploiting adaptive memory, which blend harmoniously with the structure of Scatter Search. From a historical perspective, the dedicated use of heuristic strategies both to guide the process of combining solutions and to

enhance the quality of offspring has been heralded as a key innovation in evolutionary methods, giving rise to what are sometimes called "hybrid" (or "memetic") evolutionary procedures. The underlying processes have been introduced into the mainstream of evolutionary methods (such as genetic algorithms, for example) by a series of gradual steps beginning in the late 1980s.

On Arc-routing Problems Montréal : Université de Montréal, Centre de recherche sur les transports
This book deals with complex variants of Travelling Salesman Problem (TSP) and Vehicle Routing Problem (VRP) within the manufacturing and

service industries. The objective is to develop heuristics for these supply chain problems in order to offer practical solutions to improve operational efficiency. These heuristics are evaluated using benchmark and derived data-sets. Case studies pertaining to logistics in different industries including textile machinery manufacturing and banking are also included to demonstrate the created heuristics. High competition in today's global market has forced the organizations to invest in and focus on their logistics system. The critical function of logistics is the transportation within and across various supply chain entities.

Both supply and distribution procedure require effective transportation management. A small improvement in routing problems can lead to huge logistics savings in absolute terms. This book should appeal to executives, researchers and consultants seeking supply chain management solutions. Assignment and Matching Problems: Solution Methods with FORTRAN-Programs Springer Science & Business Media Some of the most common decisions to be taken within a logistic systems at an operational level are related to the design of the vehicle routes. Vehicle Routing Problems and Arc Routing Problems are well-known families of

problems addressing such decisions. Their main difference is whether service demand is located at the vertices or the edges of the operating network. In this thesis we focus on the study of several arc routing problems. We concentrate on three families of problems. The first family consists of Multi Depot Rural Postman Problems, which are an extension of Rural Postman Problems where there are several depots instead of only one. The second family of problems that we study are Location-Arc Routing Problems, in which the depots are not fixed in advance, so their location becomes part of the decisions of the problem. We finally study Target-Visitation

Arc Routing Problems, where the service is subject to an ordering preference among the connected components induced by demand arcs. Different models are studied for each considered family. In particular, two different Multi Depot Rural Postman Problem models are considered, which differ in the objective function: the minimization of the overall transportation cost or the minimization of the makespan. Concerning Location-Arc Routing Problems, we study six alternative models that differ from each other in their objective function, whether there is an upper bound on the number of facilities to be located, or whether there are capacity constraints on the demand that can

be served from selected facilities. Finally, two Target-Visitation Arc Routing Problem models are studied, which differ from each other in whether or not it is required that all the required edges in the same component are visited consecutively. The aim in this thesis is to provide quantitative tools to the decision makers to identify the best choices for the design of the routes. To this end and for each considered problem, we first study and analyze its characteristics and properties. Based on them we develop different Integer Linear Programming formulations suitable for being solved through branch-and-cut. Finally, all formulations are tested through

extensive computational experience. In this sense, for Multi Depot Rural Postman Problems and Location-Arc Routing Problems we propose natural modeling formulations with three-index variables, where variables are associated with edges and facilities. For some of the models we also present alternative formulations with only two-index variables, which are solely associated with edges. Finally, for the Target-Visitation Arc Routing Problems we propose three different formulations, two alternative formulations for the general case, and one for the clustered version, where all the edges in the same components are served

sequentially, which exploits some optimality conditions of the problem.

Heuristics for Large-scale Capacitated Arc Routing

Problems on Mixed Networks MIT Press

This comprehensive and clearly structured book presents essential information on modern Location Science. The book is divided into three parts: basic concepts, advanced concepts and applications. Written by the most respected specialists in the field and thoroughly reviewed by the editors, it first lays out the fundamental problems in Location Science and provides the reader with basic background information on location theory. Part II covers advanced models and

concepts, broadening and expanding on the content presented in Part I. It provides the reader with important tools to help them understand and solve real-world location problems. Part III is dedicated to linking Location Science with other areas like GIS, telecommunications, healthcare, rapid transit networks, districting problems and disaster events, presenting a wide range of applications. This part enables the reader to understand the role of facility location in such areas, as well as to learn how to handle realistic location problems. The book is intended for researchers working on theory and applications involving location problems and models. It is also suitable as a

textbook for graduate courses on facility location.

Metaheuristics for Vehicle Routing Problems Springer

This book is dedicated to metaheuristics as applied to vehicle routing problems.

Several implementations are given as illustrative examples, along with applications to several typical vehicle routing problems. As a first step, a general presentation intends to make the reader more familiar with the related field of logistics and combinatorial optimization. This preamble is completed with a description of significant heuristic methods classically used to provide feasible solutions quickly, and local improvement moves

widely used to search for enhanced solutions.

The overview of these fundamentals allows appreciating the core of the work devoted to an analysis of metaheuristic methods for vehicle routing problems. Those methods are exposed according to their feature of working either on a sequence of single solutions, or on a set of solutions, or even by hybridizing metaheuristic approaches with others kind of methods.

A Parallel Insert Method for the Capacitated Arc Routing Problem

Montréal : Centre for Research on Transportation = Centre de recherche sur les transports (C.R.T.)

Arc routing problems are prevalent in our

world today. They are important to society and businesses on a daily basis. The purpose of this work is to consider a problem that has not been addressed in the literature. That problem is how to find the maximal weighted tour of an undirected set of arcs that visits all of the edges within some time constraint, and no edge twice within some time buffer. This problem, similar to most arc and vehicle routing problems, is known to be NP-hard, and thus can only be solved optimally for the most simplistic problems. Furthermore, being a mixed-integer nonlinear program, most solvers may not be able to guarantee a solution is optimal for even small problem

instances. To be able to address realistic problem sets with a large number of vertices, a comparative, route-building heuristic was developed to find a near optimal tour. This heuristic, the mixed-integer nonlinear program solver, and a hand solution were all compared for a relatively simple four node network problem. The program for the mixed-integer nonlinear solver could not solve the problem optimally. A hand solution found for the network was used to show the formulation's accuracy through the solver program, and was checked for general optimality by the solver. A heuristic was built that was able to find this optimal solution. It is assumed

that the heuristic is scalable and hence will also provide a near optimal solution for higher complexity problem instances with a larger number of nodes and arcs.

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