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Book Selection

Edited by U Aickelin

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Heavy Traffic Analysis of Controlled Queuing and Communication Networks

HJ Kushner

Springer, 2001. 513pp. £52.50
ISBN: 0387952640

'The aim of this book is the development of the heavy traffic approach to the modelling and analysis of queuing networks, both controlled and uncontrolled, and many applications to computer, communications, and manufacturing systems.' By the term heavy traffic, the author means situations where the average fraction of time at which a server or processor is free, is small, or where the communication medium has little spare capacity. The author, who is a well-experienced scholar in this field, provides his treatment of the subject throughout 12 chapters and a preface of some 520 pages. After a motivational start, three chapters consider the mathematical background (martingales, stochastic differential equations, ergodic and control theory). These chapters give the reader a profound background knowledge. Prospective readers, however, should keep in mind that even these background chapters need some prerequisites. Chapters 5 to 12 provide a really nice and comprehensive development of fundamental as well as advanced models and problems. This includes heavy traffic analysis of the uncontrolled problem, the classical control problem, singular control problems, the polling problem as well as assignment and scheduling.

The book provides some nice reading and can even be used as advanced course material (for instance, for an advanced or high-level graduate or PhD course). Every chapter starts with some helpful overview about what is to be expected and then immediately goes into detail. As the title of the book suggests, the modelling of communication networks plays an important role in the examples chosen throughout the chapters. And certainly, important references to practical problems are given especially in Chapter 1 (Sections 3 to 5). However, this does not really go far enough to be called 'real-world' applications (the book has appeared as Volume 47 of the 'Applications of Mathematics' series).

The examples are of such a general nature (polling, multiplexing, best effort access) that they cover a very broad range of important practical problems in current communication networks. For each of these examples, mathematical models for a broad variety of sub-problems form the main part of the book. However, the treatment of the models mostly takes place in a purely mathematical way. Hints towards more specific real-world applications are, as the author himself states in the introduction, 'scattered throughout the text,' but they are rare. Some technologies like ISDN or CDMA are mentioned, but mostly in the introductions of some sub-chapters. Then the focus is quickly turned back to more general problem descriptions and/or mathematical formulations.

A major advantage of this approach is the fact that the book will probably be useful as (theoretical) background for today's as well as tomorrow's problems because many concepts are so fundamental that they will not become outdated like a technology would. The ever-growing demand for communication creates an almost explosive need for the planning of communication networks and for the expansion of existing systems. And there is profound reasoning why these systems need to be studied when run at 100% or slightly below.

Furthermore, the book is clearly structured and the concepts and ideas are well explained and supported by examples. The concepts are first explained in words and then exemplified by means of mathematical approaches that may be adopted to realistic real-world cases. On the other hand, the reader has to fill the gap between the description of a general mathematical problem and a current real-world application more or less by himself. But without doubt, a

reader with profound background knowledge about the applications as well as about the mathematical background should be able to do so. That is, those armed with the necessary prerequisites enjoy seeing that their models may be useful and are acknowledged. The reader can gain a lot of general ideas applicable to heavy traffic situations. And overall, even if it is hard at times, it is fun to study this book.

Univesitaet Hamburg - Wirtschaftsinformatik S Voss

Handbook of Metaheuristics (International Series in Operations Research and Management Science)

FW Glover and GA Kochenberger (eds)

Kluwer Academic, 2003. 570pp. £117.00
ISBN: 1402072635

For the uninitiated: the term 'heuristic' refers to solution methods/algorithms that cannot guarantee to find optimal (or even good) solutions. The addition of the syllable 'meta' refers to the fact that over the years these heuristics have become much more complicated than simple rules of thumb and often consist of a number of sub-heuristics themselves. Now you might ask, why would anyone want to use a solution method that does not promise to find good solutions? The simple answer is because that's the best we have for some combinatorial optimization problems and most of the time they do a good enough job for all intents and purposes.

The 'Handbook of Metaheuristics' consists of 19 chapters each describing one metaheuristic. Every chapter is authored by one or more experts in the individual field, for example, John Koza talks about Genetic Programming and Marco Dorigo writes about Ant Colony Optimization. The fact that the book has been written by some 40 authors is both its main strength and weakness. Please let me elaborate.

Having read about half the chapters in more detail, I am satisfied that their individual contents are of high quality. For instance, I have researched in the area of genetic algorithms for a number of years. In Chapter 3, Colin Reeves gives a background, general description and brief summary of the main components of genetic algorithms. I think he does a great job and I'd be more than happy to give this chapter to an incoming PhD student who wants to know the basics of the area. Reading other chapters, I judge them to be of similar, high quality, equally suitable for a newcomer to get to the grips with the basics.

However, is the book more than the sum of its parts, that is, chapters? The answer is probably no. Although the editors have taken care to make the 19 chapters look and feel the same by using a standard template throughout, it is nevertheless obvious that the book is written by a large number of individuals. Some chapters are what I would call 'practitioner oriented' while others 'err' more on the theoretical side. This is not a problem in itself for each individual part. However, I wonder whether the editors should have been a little stricter by perhaps prescribing standard sub-chapter headings. Also, maybe inevitably, there are repetitions throughout the book, for example, terms such as 'heuristic', 'metaheuristic' and 'optimization' are explained numerous times.

Perhaps what is missing from this book is an overarching summary, which might also include key definitions. As it stands, the book is very good at teaching what each of the individual heuristics is about. After a little while the more advanced reader will ask questions such as 'so how exactly does method X differ from Y' and 'where is the area of meta-heuristics moving to in the future'. Answers to these questions are not provided.

So, in short, an excellent book if you want to learn about a number of individual metaheuristics, but it fails to provide an overarching overview.

University of Nottingham U Aickelin

Key Concepts in Operations Management (Palgrave Key Concepts)

J Sutherland and D Canwell

Palgrave Macmillan, 2004. 277pp. £12.00
ISBN: 1403915296

This book is part of the Palgrave Key Concepts series of books and as such is a relatively slim volume of 277 pages. Nevertheless, the book is full of useful definitions and summaries of the topics covered and is more like a dictionary or glossary than anything else. I liked this book and found the material covered of some value. Many topics are covered in some detail including reference to source materials and web sites. There are explanatory diagrams, tables and figures, which contribute by succinctly describing and explaining each concept and idea with sufficient information that the reader will be familiar with the concept and its application in practice. There is a very good index and phrases in bold in each entry in the book allow quick cross-reference to related topics and concepts. Similarly, at the end of many entries there are alternative or complementary entries related to the topic listed, which aids cross-referencing and tracking down the various concepts needed to understand the subject fully.

The book is well-written, clear, tidy, user-friendly. It is quite a charming little book, which is a pleasure to read. Some of the material presented actually made me think I should incorporate these items into some of my Operations Management modules. Service operations are covered with SERQUAL, blueprinting and service level while project management is covered with critical path method, PERT, activity on arrow and activity on node and so on. Quality

issues, concepts and terms are covered in some detail while numerous Japanese words and phrases are liberally scattered throughout the book. While obviously not a comprehensive textbook on the theory and practice of Operations Management, it does manage to introduce an awful lot of material in an easily read and accessible way.

Some entries are too short for my liking and do not adequately reflect the importance of those topics in my opinion. Other readers may disagree by having a completely different view of operations management. This is the frustrating part about this book. Some entries are quite comprehensive and the reader will appreciate these descriptions and explanations but at the same time also be frustrated by other entries that only scratch the surface or give a partial view of the topic. This is an unfortunate, but predictable, side effect of such a text and is also the reason why a jolly good companion textbook is needed to explain the topic fully. Perhaps the authors might consider such a companion textbook in the near future. I hope so.

The book is not intended to be read from start to finish, but used as a reference text to the main ideas and concepts in Operations Management. This leads me on to the intended audience for such a text. The text is insufficient as a recommended text for any student module (except perhaps a first year undergraduate introductory module), but would be an excellent quick reference text as a companion to any text in Operations Management. I might even suggest that the book would make a quick revision guide for students sitting for examinations in the subject. However, the issue is who is this book for? The introductory remarks by the publishers suggest that the book is a companion book to a standard text, invaluable to students throughout their course and as a revision aid. This seems like a very good idea to me, but I remain unconvinced that students would buy such a text given the cost of standard texts these days. Nevertheless, I liked the book, thought it good value for money and will add it to my list of items to buy for the library.

Sheffield University M Simpson

Representations for Genetic and Evolutionary Algorithms

F Rothlauf

Springer-Verlag, 2004. 303pp. £46.00
ISBN: 3540006109

This book presents an investigation into the effect that representations have on the performance of genetic and evolutionary algorithms. Mainly three aspects of representations are considered: redundancy, scaling and distance distortion, and their effect on the solution quality and convergence time. The book provides a theoretical framework supported by extensive experimentation.

The introduction is well written and gives a clear overview of the aims, contents and organization of the book. Two topics are presented and discussed in Chapter 2, one is the relationship between genotypes and phenotypes and the other is the use of direct and indirect encodings in genetic and evolutionary algorithms. However, the description of types of representations is rather superficial and more examples are required. Although the reader should have previous knowledge on genetic and evolutionary algorithms, the chapter should also give a brief overview on this topic. In particular, the presentation on the schema theorem and the building block hypothesis given in this chapter is very good.

The influence of redundancy, scaling and distance distortion on the performance of genetic and evolutionary algorithms is illustrated in Chapter 3 in an excellent manner. This chapter is of high value because it offers a good insight into some of the important issues to consider when designing and selecting representations for genetic and evolutionary algorithms. A theoretical framework for analysing and predicting the effect of representations on the performance of genetic and evolutionary algorithms is presented in Chapter 4. The framework is well developed and described and it represents a very important step towards the construction of a theory of representations.

The effect of representations when solving integer problems using genetic algorithms that are based on selection and recombination is investigated in Chapter 5. This investigation is slightly limited in scope because it considers only binary, gray and unary representations and not mutation operators that are common in most implementations. Therefore, the observations and conclusions made should be taken with caution. The effect of representations when solving tree optimization problems using (selection + recombination) genetic algorithms is investigated in Chapter 6. This chapter gives a very good introduction to network optimization and then nicely illustrates that locality of the representations is very dependant on the problem structure. This chapter is particularly well written and provides a great number of very valuable references. In Chapter 7, the author illustrates how the theoretical framework introduced in Chapter 4 can be used for designing new representations for trees in a theory-guided manner. This chapter presents considerable experimental results to illustrate the above. Chapter 7 is somehow unbalanced because since integer and tree problems were covered in Chapters 5 and 6, the reader would also like to see examples of how better representations can be designed for integer problems. Based on the theoretical framework described in Chapter 4, Chapter 8 illustrates how representations can be selected and their performance predicted when solving scalable test and real-world problems. This chapter is well presented and practitioners would find it of high value. The chapter presents and discusses extensive experimental results that illustrate in a very clear way how redundancy, scaling and

distance distortion in various representations affect the performance of genetic and evolutionary algorithms. The author selected test and real-world problems that are readily available from the literature, which gives additional value to the experiments and results presented. Finally, Chapter 9 of this book gives a good summary, highlights the contributions of the book, draws conclusions and suggests future work. This chapter is excellent because the author managed to communicate the above issues in a very clear and concise way.

Overall, the reviewer believes that this is a very good book. The title is somewhat misleading because one may expect to read about types and properties of the many representations that have been proposed for genetic and evolutionary algorithms. Nevertheless, this book is of high value for researchers interested in the field of evolutionary computation. Practitioners would also find some of the chapters of the book useful (eg Chapters 2, 7 and 8) where some issues and guidelines on how to select representations are discussed. However, the reviewer's opinion is that this book needs to be read as a whole without skipping chapters in order to understand the most important ideas and concepts.

University of Nottingham D Silva

Graph Drawing Software

M Junger and P Mutzel

Springer-Verlag, 2004. 370pp. £54.00
ISBN: 3540008810

There is a seemingly endless number of situations where the most effective means to explain the matter at hand is to draw a graph. For operational researchers in particular, graphs are ubiquitous: decision trees, the network simplex method, and branch-and-bound trees immediately come to mind. Indeed, graphs have wide applicability in science, and a quick browse through the pages of Graph Drawing Software powerfully makes this point. The ability to visualize graphs is vital to most, if not all, of these applications, and although every graph is mathematically unique, there are many ways to represent a given graph visually. Graph drawing is concerned with all aspects of algorithms for automatically generating 'nice' graph layouts.

Although the concept of what makes a layout 'nice' is ambiguous, there are several specific properties that are intuitively desirable for representations of graphs: an obvious one is to minimize the number of edge crossings. The first paper in the history of graph drawing, 'How to draw a graph', was written by WT Tutte in 1963, and proposed that each vertex should be placed into the centre of its neighbours. Research in this area grew over the years, and by the early 1990 s there was sufficient interest to motivate the first Symposium on Graph Drawing. This event has been held annually since then.

The book under review originated in the Ninth Symposium, held in 2001, which included a software exhibition presenting several software tools developed by the graph drawing community. The book consists of 15 chapters: the first is a short introduction to the mathematical foundations of the area, and the remaining are invited articles on state-of-the-art software tools presented at the aforementioned exhibition. While seven of these tools are customized for specific applications such as visualizing biochemical pathways or relational database schema, the remaining seven present general-purpose tools for efficiently and effectively representing graphs.

As befits the subject at hand, this book is abundantly illustrated with over 200 figures, the vast majority of which are in colour. The spacious layout of the text, interleaved with so many colourful figures, makes the book a pleasure to read. Each chapter can be read independently, and while the writing style varies among chapters, the presentation is consistently focused on the features of each tool, with appropriate references to the relevant specialized literature for the interested reader.

While it is clearly of interest to members of the graph drawing community, this book is in fact geared to potential users of the software tools in other areas, and as such it is of interest to anyone making use of graphs in their scientific endeavours. Although it is available only in hardcover, it is reasonably priced, and it definitely deserves a place on a library's bookshelves as well as on the bookshelves of those who wish to enhance their teaching and research presentations with compelling depictions of graphs.

University of Southampton M Anjos

Linear Programming: Theory and Extensions (Springer Series in Operations Research)

GB Dantzig and MN Thapa

Springer-Verlag, 2004. 448pp. £40.00
ISBN:0387986138

This book has a remarkable pair of authors. George Dantzig is widely regarded as the founder of linear programming (LP) with his invention of the simplex algorithm in the 1940s. Mukund Thapa is a practitioner with extensive experience in applying, since the late 1970s, theoretical results from various areas including LP to a variety of practical problems.

Perhaps, as a result of this relatively rare collaboration, the book covers LP of interest to researchers and to practitioners. The book is a continuation of 'Linear Programming 1: Introduction' by the same authors, but can be read by anyone familiar with the basics of LP and

linear algebra from other books, as the authors recall necessary notions and results from 'Linear Programming 1' when they are needed. The book contains a large number of examples to illustrate definitions and results. This certainly helps the reader to gain quickly the necessary intuition and confidence to proceed in understanding not only relatively simple concepts and results, but also more advanced ones.

While some material is quite advanced and outside the essentials of LP, the book contains a number of topics important for the reader who wants to know LP beyond a very basic level. These topics include geometry of LP, duality theory and related results, dual simplex and primal–dual simplex algorithms. The book contains more advanced topics such as interior-point methods (early and current methods), degeneracy, decomposition of large-scale systems, generalized upper bounds and introduction to stochastic programming. In many other introductory textbooks, only a few theorems on LP are proved; in this book, however, proofs are provided for all theorems stated and those that were sketched but not proved in 'Linear Programming 1.'

The book also provides a historic account of LP development over the years. Some of the information is hard to find elsewhere. This is also true for some technical material including an informative account of early interior-point methods.

In my view, the only topic which is not treated in enough detail is flows in networks. However, this topic is relatively unimportant for the main material of the book and it is covered very well in several other books.

While the book is intended as an advanced graduate-level text, I believe that the book, with its wealth of material and detailed examples, is very useful also to upper undergraduate students in mathematics, computer science, operational research and related areas as well as to researchers and practitioners. The book can be used as a reference.

All in all, I think the book is a good value for money for both libraries and individuals.

Royal Holloway College, University of London G Gutin