Preface

One of the most well-known of all network optimization problems is the shortest path problem, where a shortest connection between two locations in a road network is to be found. This problem is the basis of route planners in vehicles and on the Internet. Networks are very common structures; they consist primarily of a finite number of locations (points, nodes), together with a number of links (edges, arcs, connections) between the locations. Very often a certain number is attached to the links, expressing the distance or the cost between the end points of that connection.

Networks occur in an extremely wide range of applications, among them are:

- road networks;
- cable networks;
- human relations networks;
- project scheduling networks;
- production networks;
- distribution networks;
- neural networks;
- networks of atoms in molecules.

In all these cases there are “objects” and “relations” between the objects. A network optimization problem is actually nothing else than the problem of finding a subset of the objects and the relations, such that a certain optimization objective is satisfied.

Why a book with computer exercises on network optimization? First of all, network problems in practice are mostly very large and extremely complicated. Only with the assistance of computers high quality solutions can be obtained. Most books in this field only offer exercises that support the understanding of the theory. The case studies, that are discussed in the literature, are usually not suitable for classroom analysis, since the data sets are missing, or are much too large to handle in a classroom setting.

This book contains a wide range of not too large network optimization problems, that need to be analyzed and solved by using the computer. The emphasis of the book is not on solution techniques. The reader may find her favorite software on
the Internet. Some suggestions for associated readings and Internet sites related to optimization are provided in Chapter C of the book.

Even the first theoretical chapter is written in the spirit of the book. The reader learns the basic concepts within the framework of networks and computer techniques.

The prerequisites for this book are minimal. All theoretical concepts are clearly explained. However, the reader is highly recommended to use this book in combination with a textbook on the subject. Our suggestion is *Graphs, Networks, and Algorithms* by D. Jungnickel [18]. This book contains a collection of major network optimization problems together with the main solution techniques. It also contains a wide range of interesting examples. The book is clearly written and very accessible. (Further suggestions for textbooks are given in the Chapter C of the book.) The literature list contains suggestions on this subject as well. We advice the reader to examine some introductory graph theory and linear programming/optimization theory.

What actually is the subject that this book refers to? An Internet search on the term “network optimization” does not result in many textbooks. The reason is obvious. Network optimization is related to a broad range of disciplines, including:

- quantitative logistics
- combinatorial optimization
- integer programming
- operations research
- discrete mathematics
- algorithmic graph theory
- supply chain logistics
- network theory
- integer linear programming
- management science
- finite mathematics
- computer science

The closest related disciplines to network optimization are combinatorial optimization and quantitative logistics. Combinatorial optimization deals with problems where solutions are combinations of the “objects” and the “relations” in the problem. The number of such solutions is finite but typically very large. A decision maker needs to choose a solution that satisfies a pre-specified objective. Quantitative logistics deals with logistics and supply chain management problems that have been formulated in mathematical terms. So literature on the subjects of combinatorial optimization and quantitative logistics are usually the best choices to know more about network optimization.

In order to avoid that the book would become a disconnected set of exercises, we use the fictitious company Global Telecom Company (GTC) as a common theme throughout. The international market for telecommunication is still one of the fastest growing markets in the world. There is an increasing demand for more and more customer-specific products and services. Also in this market, the supply chains from product-suppliers via manufacturers, distribution centers, warehouses and retailers to the final customers have made a shift from “make-to-stock” to the customer-specific “make-to-order” concept. Outsourcing and focusing on core-business have become the key success factors. Demand-supply chain management, where all links in the production network cooperate, is a key issue for surviving and for obtaining the necessary competitive advantage over other supply networks. Finding the balance between on one hand maximizing the customer service, and on the other hand min-

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imizing the total costs, wastes, and inventories is done on a supply chain/network scale. GTC operates in this scenario.

GTC has businesses in various countries across the world. The company manages a large worldwide telecommunication system, and produces sophisticated equipment for telecommunication. GTC operations are divided into a number of largely independent operation divisions, such as “Research & Development”, “Cables”, and “Services”. One of the main goals of GTC is to extend its position as an important supplier of telecommunication services, with an emphasis on a continuous improvement of the price-quality relations of its products and services.

These facts justify a look at network optimization from a telecommunication point of view. The problems have been carefully selected and formulated and reflect a high degree of realism, although the reality is not always reached completely. When faced with the choice between realism on one hand and didactic justification on the other, we have often chosen for the latter. We have formulated problems with data sets that are manageable and surveyable for the student, but too large to be solved “by inspection”.

The exercises in the book have been extensively tested in classroom settings. Many of our students’ suggestions to improve the clarity of the questions have been implemented. However, we are eager to obtain further suggestions on improving the book. These may be sent by email to the authors’ addresses (g.sierksma@rug.nl and diptesh@iimahd.ernet.in). Nevertheless, some questions may not be completely clear to the reader. In such cases, the reader is challenged to formulate her/his own interpretation of the question. Even a number of alternative scenarios may be considered. In practical situations, when the management is not completely clear about the formulation of a problem, a pro-active approach of proposing alternative scenarios may be effective, especially in understanding the problem more clearly.

Many persons have contributed to the final version of this book. We would especially like to mention the contributions of Matthijs Streutker, who provided the first version of the chapter on facility location, and devised the software for solving the problems, and Marc-Jan Menkhorst for providing the first version of the chapter on matching. Any errors that remain in the book are of course the responsibility of the authors.

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