

国外计算机科学教材系列

# 数据库处理

—— 基础、设计与实现 (第七版)

Database Processing

Fundamentals, Design & Implementation

Seventh Edition

英文版

[美] David M. Kroenke 著



电子工业出版社

Publishing House of Electronics Industry  
<http://www.phei.com.cn>

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## 内 容 简 介

本书从实用角度出发,从用户、数据库和应用之间的关系入手,深入阐述了数据建模、应用设计与实现等技术。全书由七个部分组成,内容包括:数据库应用的构件和基本功能等概念;数据库建模与设计;在描述实体-联系模型的同时,主要描述语义对象模型以及两种模型下的数据库设计;讨论使用关系模型进行数据库实现,包括关系实现基础、SQL语言和数据库应用;介绍 Internet 技术的数据库应用、管理多用户数据库及访问数据库服务器;讨论企业数据库和面向对象数据库的处理。本书既可作为计算机专业的教材,也可作为数据库领域工程技术人员的参考书。

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# 出版说明

21世纪初的5至10年是我国国民经济和社会发展的关键时期，也是信息产业快速发展的关键时期。在我国加入WTO后的今天，培养一支适应国际化竞争的一流IT人才队伍是我国高等教育的重要任务之一。信息科学和技术方面人才的优劣与多寡，是我国面对国际竞争时成败的关键因素。

当前，正值我国高等教育特别是信息科学领域的教育调整、变革的重大时期，为使我国教育体制与国际化接轨，有条件的高等院校正在为某些信息学科和技术课程使用国外优秀教材和优秀原版教材，以使我国在计算机教学上尽快赶上国际先进水平。

电子工业出版社秉承多年来引进国外优秀图书的经验，翻译出版了“国外计算机科学教材系列”丛书，这套教材覆盖学科范围广、领域宽、层次多，既有本科专业课程教材，也有研究生课程教材，以适应不同院系、不同专业、不同层次的师生对教材的需求，广大师生可自由选择 and 自由组合使用。这些教材涉及的学科方向包括网络与通信、操作系统、计算机组织与结构、算法与数据结构、数据库与信息处理、编程语言、图形图像与多媒体、软件工程等。同时，我们也适当引进了一些优秀英文原版教材，本着翻译版本和英文原版并重的原则，对重点图书既提供英文原版又提供相应的翻译版本。

在图书选题上，我们大都选择国外著名出版公司出版的高校教材，如Pearson Education培生教育出版集团、麦格劳-希尔教育出版集团、麻省理工学院出版社、剑桥大学出版社等。撰写教材的许多作者都是蜚声世界的教授、学者，如道格拉斯·科默(Douglas E. Comer)、威廉·斯托林斯(William Stallings)、哈维·戴特尔(Harvey M. Deitel)、尤利斯·布莱克(Uyless Black)等。

为确保教材的选题质量和翻译质量，我们约请了清华大学、北京大学、北京航空航天大学、复旦大学、上海交通大学、南京大学、浙江大学、哈尔滨工业大学、华中科技大学、西安交通大学、国防科学技术大学、解放军理工大学等著名高校的教授和骨干教师参与了本系列教材的选题、翻译和审校工作。他们中既有讲授同类教材的骨干教师、博士，也有积累了几十年教学经验的老教授和博士生导师。

在该系列教材的选题、翻译和编辑加工过程中，为提高教材质量，我们做了大量细致的工作，包括对所选教材进行全面论证；选择编辑时力求达到专业对口；对排版、印制质量进行严格把关。对于英文教材中出现的错误，我们通过作者联络和网上下载勘误表等方式，逐一进行了修订。

此外，我们还将与国外著名出版公司合作，提供一些教材的教学支持资料，希望能为授课老师提供帮助。今后，我们将继续加强与各高校教师的密切联系，为广大师生引进更多的国外优秀教材和参考书，为我国计算机科学教学体系与国际教学体系的接轨做出努力。

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# PREFACE



In 1983, the popularity of the IBM personal computer prompted one industry pundit to write, “After years of explosive growth, the computer industry has finally reached its infancy.” Today, the same statement can be made about the Internet: After years of explosive growth, the Internet has finally reached its infancy.

True enough, but why does the Internet matter to database processing? Part of the answer is that the Internet tremendously amplifies the importance of database technology, knowledge, and skills. Chapter 13 shows how to call Active Data Objects from script code in Microsoft IIS Active Server Pages for the purpose of listing a table. Basically, the example wraps a straightforward SQL SELECT statement with Internet technology to perform a task that was simple many years ago. This isn’t particularly special except that, as of December, 1998, 153 million people worldwide can view that table with software that is already in place on their computer!

The Internet (and organizational intranets) need database technology to move from brochure publishing to application publishing. We know the stories of Amazon.com, Dell Computer, and other well-known “e-tailers.” Database applications are, of course, critically important to those companies. Lesser known are smaller companies like the yacht broker in Seattle who used a database application to sell a boat located in Hawaii to a customer living in North Carolina. The broker never met the buyer nor saw the boat. The contract was negotiated over the Web, the buyer flew to Hawaii to inspect the boat, and the deal was done. The net was \$4700 to the broker for basically an Internet information service.

The Internet is important to database processing not only as amplifier, however, but also because of the new technologies being developed. I believe that XML (see Chapter 11) is the most important development for database processing since the relational model. What justifies such a dramatic statement? By separating structure, content, and materialization, XML is the perfect protocol for exchanging database views. Because it is extensible in a standardized way, and because it readily represents arbitrary hierarchical structures, XML provides a superior means for organizations to exchange database views. In time, XML will revolutionize electronic data interchange.

Now, before we all run off to our offices shrieking in panic about the amount of new technology to be learned, consider this perspective: Internet technology provides a wrapper around the fundamentals we have always taught. Thus, I believe we need first to teach data modeling, normalization, database design, database application design, and then follow that by teaching the application of these fundamentals for the

Internet and organizational intranets. Hence, in this text, the first 10 chapters address fundamentals; it is only the next three that concern Internet technologies.

One last note on important new developments—with Office 2000, Microsoft will place its Pivot Table Service on the desktops of the world. This service is a desktop version of its OLAP server and, indeed, it can process not only local OLAP cubes, but also those stored on remote computers providing OLAP services for large databases. Hence, this edition augments the data warehousing material in Chapter 14 with a substantial discussion of OLAP.

## Microsoft Access and SQL Server and Wall Data's DBApp

I have used Access 2000 to illustrate discussion points throughout the text. This is done primarily to give form and substance to otherwise ethereal ideas. Also, since Access is the world's most popular database management system (DBMS), it is the product students are most likely to have now and to encounter later in their careers.

In addition to Access, the Microsoft Corporation agreed to license the Evaluation Edition of SQL Server 7.0 to users of this text, free of charge. A copy of this software is shrink-wrapped with this text. This version of SQL Server 7.0 can be run on Windows 95, Windows 98, Windows NT, and Windows 2000. It requires a 166 MHz or higher Pentium processor, 32 megabytes of RAM, and from 65–180 MB of disk storage. The license for this software lasts for 120 days from the date of installation, which should be more than adequate for student use in your course. Installation and use of SQL Server is described in Appendix B.

Appendix C presents Wall Data's DBApp. This software, which is available for free to students from the Prentice Hall Web site ([www.prenhall.com/kroenke](http://www.prenhall.com/kroenke)), can be used to create semantic object data models, to generate both Access and SQL Server database schemas, and to create .asp pages for publishing database views on the Web. DBApp will also reverse engineer existing databases and create semantic object models from them. See Appendix C for more information.

## Organization of This Book

This text is organized into seven parts. Part I provides an introduction. A number of different types of databases and applications are presented in Chapter 1, along with important definitions and a brief history of database processing. Chapter 2 illustrates the components of a DBMS and provides an overview of the process of building a database and related applications.

The focus of Part II is on data modeling. Chapter 3 explains the concepts and constructs of the entity-relationship model and illustrates its use. Chapter 4 presents the semantic object model in a similar way. Either of these models can be used to express the users' data requirements.

Part III discusses the transformation of data models into relational database designs. Chapter 5 sets

the stage by discussing the relational model and normalization. Normalization techniques are then used in Chapter 6 to explain the transformation of entity-relationship data models into relational designs and in Chapter 7 to explain the transformation of semantic object models into relational designs.

The implementation of relational databases is presented in Part IV. Chapter 8 discusses the foundations of relational implementation and relational algebra. Chapter 9 then presents SQL in a DBMS-independent manner. Chapter 10 concludes Part IV by discussing the design of database applications. This chapter sets the stage for the next three chapters by making a clear distinction between database views and materializations on database views. It also discusses application roles in the enforcement of constraints and business rules.

Part V concerns database processing using Internet technologies. Chapter 11 introduces basic Web concepts and describes the three-tier processing architecture. Web-oriented programming languages like JavaScript, VBScript, and Java are described and the features and functions of DHTML and XML are discussed. The chapter concludes with an explanation of the role and purpose of Active Server Pages. Chapter 12 then focuses on the database server tier. Concurrency control, transaction management, backup and recovery, and security are all addressed. Finally, Chapter 13 describes standards for accessing Web databases including ODBC, OLE DB, and ADO.

Enterprise database processing is addressed in Part VI. Chapter 14 discusses enterprise database system architectures, describes the processing of downloaded data, and surveys OLAP. It concludes with a discussion of data warehousing and data administration. Chapter 15 then presents a case example of DB2 and Chapter 16 discusses the hierarchical and network data models. Both of these models are old but have come back into prominence because of the need to fix Y2K problems as well as the need to find some way to put their data on the Web. OLE DB will give new importance to IMS to our students.

Chapter 17, the sole chapter in Part VII, addresses object-oriented DBMS technology. While such databases are of conceptual interest, they play, at most, a minor role in commercial database processing. This chapter therefore presents basic concepts so that students will be familiar with the important ODBMS terminology and standards.

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Thanks to the Microsoft Corporation for the complementary license to readers of this text for SQL Server 7.0. I am especially grateful to John Wall and the executive team at Wall Data for the complementary license to use DBApp and also for their continuous support of the educational community since 1992. Many of the ideas in this text arose from delightful and interesting conversations with Wall Data employees and especially with Ted Carroll, Lee Eggebrotten, Ed Fogard, Mike Gardner, Pat Hammack, Kenji Kawai, Michael Miller, Nick Nichols, Chris Olds, Charles Porter, Danny Rosenthal, and Cathy Stanford. I am most grateful to all of them for their time, their thoughts, and their consideration. Finally, a special thanks to Lynda, whose delightful presence has been not only an inspiration but also a steadfast support through thick and thin.

The computer industry is as exciting and interesting today as at any time since I entered it in 1967. I sincerely hope that readers of this text will have as much fun with this technology as I have had. If they have even half as much, they will truly be blessed.

David Kroenke  
Seattle, Washington

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# INTRODUCTION

The two chapters in Part I introduce the topic of database processing. Chapter 1 describes four typical database applications and discusses the advantages of databases over earlier file-processing systems. It also defines the term *database* and surveys the history of database processing. Chapter 2 then summarizes the tasks necessary to develop a database and related applications. It also describes the elements of a database and surveys the functions of the DBMS as well.

This part provides an overview of the need for databases and the nature of the components of databases and their related applications. Its purpose is to set the stage for your study of the details of database technology in subsequent chapters.