Editor in Chief: Stephanie Wall
Acquisitions Editor: Nicole Sam
Program Manager Team Lead: Ashley Santora
Program Manager: Denise Vaughn
Editorial Assistant: Kaylee Rotella
Executive Marketing Manager: Anne K. Fahlgren
Project Manager Team Lead: Judy Leale
Project Manager: Ilene Kahn
Head of Learning Asset Acquisition: Laura Dent
Publishing Administrator and Business Analyst, Global Edition: Shokhi Shah Khandelwal

Acquisitions Editor, Global Edition: Sandhya Ghoshal
Project Editor, Global Edition: Sinjita Basu
Senior Manufacturing Controller, Production, Global Edition: Trudy Kimber
Procurement Specialist: Michelle Klein
Senior Art Director: Janet Slowik
Text Designer: Integra Software Services
Cover Designer: Lumina Datamatics Ltd
Cover Photo: Shutterstock
Full-Service Project Management: Integra
Cover Printer: Lehigh-Phoenix Color/Hagerstown

Pearson Education Limited
Edinburgh Gate
Harlow
Essex CM20 2JE
England
and Associated Companies throughout the world

Visit us on the World Wide Web at: www.pearsonglobaleditions.com

© Pearson Education Limited 2015

The rights of David M. Kroenke and David J. Auer to be identified as the authors of this work have been asserted by them in accordance with the Copyright, Designs and Patents Act 1988.

Authorized adaptation from the United States edition, entitled Database Concepts, 7th edition, ISBN 978-0-133-54462-6, by David M. Kroenke and David J. Auer, published by Pearson Education © 2014.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without either the prior written permission of the publisher or a license permitting restricted copying in the United Kingdom issued by the Copyright Licensing Agency Ltd, Saffron House, 6–10 Kirby Street, London EC1N 8TS.

All trademarks used herein are the property of their respective owners.The use of any trademark in this text does not vest in the author or publisher any trademark ownership rights in such trademarks, nor does the use of such trademarks imply any affiliation with or endorsement of this book by such owners.

ISBN 10: 1-292-07623-2
ISBN 13: 978-1-292-07623-2

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

10 9 8 7 6 5 4 3 2 1
14 13 12 11 10

Typeset in 10/12 Simoncini Garamond Std. by Integra.
Printed and bound by CPI Digital UK in the United Kingdom

Brief Contents

PART I DATABASE FUNDAMENTALS 17

1 Getting Started: An Overview of Databases 19
2 The Relational Model and Database Normalization 78
3 Structured Query Language 135

PART II DATABASE DESIGN 259

4 Data Modeling and the Entity-Relationship Model 261
5 Database Design 303

PART III DATABASE MANAGEMENT 349

6 Database Administration and Management 351
7 Database Processing in Applications 408
8 Big Data, Data Warehouses, and Business Intelligence Systems 461

Glossary 511

Index 519

ONLINE APPENDICES: SEE PAGE 509 FOR INSTRUCTIONS

Appendix A: Getting Started with Microsoft SQL Server 2014 Express Edition
Appendix B: Getting Started with Oracle Database Express Edition 11*g* Release 2
Appendix C: Getting Started with MySQL 5.6 Community Server
Appendix D: James River Jewelry Project Questions
Appendix E: SQL Views, SQL/PSM, and Importing Data
Appendix F: Getting Started in Systems Analysis and Design
Appendix G: Getting Started with Microsoft Visio 2013
Appendix H: The Access Workbench—Section H—Microsoft Access 2013 Switchboards
Appendix I: Getting Started with Web Servers, PHP, and the NetBeans IDE
Appendix J: Business Intelligence Systems
Appendix K: Big Data

Contents

PART I DATABASE FUNDAMENTALS 17

1 Getting Started: An Overview of Databases 19
WHY USE A DATABASE? 20
WHAT IS A DATABASE SYSTEM? 30
WHAT IS A NOSQL DATABASE? 40
THE ACCESS WORKBENCH SECTION 1—GETTING STARTED WITH MICROSOFT ACCESS 41
Summary 70 • *Key Terms* 71 • *Review Questions* 71 • *Exercises* 72 • *Access Workbench Key Terms* 73 • *Access Workbench Exercises* 73 • *San Juan Sailboat Charters Case Questions* 75 • *Garden Glory Project Questions* 76 • *James River Jewelry Project Questions (See Online Appendix D)* 77 • *The Queen Anne Curiosity Shop Project Questions* 77

2 The Relational Model and Database Normalization 78
RELATIONS 79
TYPES OF KEYS 82
THE PROBLEM OF NULL VALUES 90
FUNCTIONAL DEPENDENCIES AND NORMALIZATION 92
NORMAL FORMS: ONE STEP AT A TIME 104
THE ACCESS WORKBENCH SECTION 2—WORKING WITH MULTIPLE TABLES IN MICROSOFT ACCESS 105
Summary 121 • *Key Terms* 122 • *Review Questions* 122 • *Exercises* 124 • *Access Workbench Key Terms* 126 • *Access Workbench Exercises* 126 • *Regional Labs Case Questions* 129 • *Garden Glory Project Questions* 130 • *James River Jewelry Project Questions (See Online Appendix D)* 132 • *The Queen Anne Curiosity Shop Project Questions* 132

3 Structured Query Language 135
AN EXAMPLE DATABASE 136
SQL FOR DATA DEFINITION (DDL)—CREATING TABLES AND RELATIONSHIPS 142
SQL FOR DATA MANIPULATION (DML)—INSERTING DATA 155
SQL FOR DATA MANIPULATION (DML)—SINGLE TABLE QUERIES 159
SQL FOR DATA MANIPULATION (DML)— MULTIPLE TABLE QUERIES 177
SQL FOR DATA MANIPULATION (DML)—DATA MODIFICATION AND DELETION 192
SQL FOR DATA DEFINITION (DDL)—TABLE AND CONSTRAINT MODIFICATION AND DELETION 195
SQL VIEWS 198
THE ACCESS WORKBENCH SECTION 3—WORKING WITH QUERIES IN MICROSOFT ACCESS 198
Summary 227 • *Key Terms* 228 • *Review Questions* 228 • *Exercises* 232 • *Access Workbench Key Terms* 234 • *Access Workbench Exercises* 234 • *Heather Sweeney Designs Case Questions* 238 • *Garden Glory Project Questions* 248 • *James River Jewelry Project Questions (See Online Appendix D)* 251 • *The Queen Anne Curiosity Shop Project Questions* 252

PART II DATABASE DESIGN 259

4 Data Modeling and the Entity-Relationship Model 261
REQUIREMENTS ANALYSIS 262
THE ENTITY-RELATIONSHIP DATA MODEL 263
ENTITY-RELATIONSHIP DIAGRAMS 268
DEVELOPING AN EXAMPLE E-R DIAGRAM 278
THE ACCESS WORKBENCH SECTION 4—PROTOTYPING USING MICROSOFT ACCESS 286
Summary 295 • *Key Terms* 296 • *Review Questions* 296 • *Exercises* 297 • *Access Workbench Key Terms* 298 • *Access Workbench Exercises* 298 • *Highline University Mentor Program Case Questions* 298 • *Washington State Patrol Case Questions* 300 • *Garden Glory Project Questions* 301 • *James River Jewelry Project Questions (See Online Appendix D)* 302 • *The Queen Anne Curiosity Shop Project Questions* 302

5 Database Design 303
THE PURPOSE OF A DATABASE DESIGN 304
TRANSFORMING A DATA MODEL INTO A DATABASE DESIGN 304
REPRESENTING ENTITIES WITH THE RELATIONAL MODEL 305
REPRESENTING RELATIONSHIPS 313
DATABASE DESIGN AT HEATHER SWEENEY DESIGNS 326
THE ACCESS WORKBENCH SECTION 5—RELATIONSHIPS IN MICROSOFT ACCESS 334
Summary 340 • *Key Terms* 341 • *Review Questions* 341 • *Exercises* 342 • *Access Workbench Key Terms* 343 • *Access Workbench Exercises* 343 • *San Juan Sailboat Charters Case Questions* 344 • *Washington State Patrol Case Questions* 346 • *Garden Glory Project Questions* 346 • *James River Jewelry Project Questions (See Online Appendix D)* 346 • *The Queen Anne Curiosity Shop Project Questions* 347

PART III DATABASE MANAGEMENT 349

6 Database Administration and Management 351
THE HEATHER SWEENEY DESIGNS DATABASE 352
THE NEED FOR CONTROL, SECURITY, AND RELIABILITY 352
CONCURRENCY CONTROL 354
SQL TRANSACTION CONTROL LANGUAGE AND DECLARING LOCK CHARACTERISTICS 360
CURSOR TYPES 364
DATABASE SECURITY 366
DATABASE BACKUP AND RECOVERY 373
ADDITIONAL DBA RESPONSIBILITIES 377
THE ACCESS WORKBENCH SECTION 6—DATABASE ADMINISTRATION IN MICROSOFT ACCESS 377
Summary 397 • *Key Terms* 399 • *Review Questions* 399 • *Exercises* 401 • *Access Workbench Key Terms* 402 • *Access Workbench Exercises* 402 • *Marcia's Dry Cleaning Case Questions* 403 • *Garden Glory Project Questions* 404 • *James River Jewelry Project Questions (See Online Appendix D)* 405 • *The Queen Anne Curiosity Shop Project Questions* 406

7 Database Processing in Applications 408
THE DATABASE PROCESSING ENVIRONMENT 409
WEB APPLICATION DATABASE PROCESSING 412
DATABASE PROCESSING AND XML 440
THE ACCESS WORKBENCH SECTION 7—WEB DATABASE PROCESSING USING MICROSOFT ACCESS 442
Summary 451 • *Key Terms* 452 • *Review Questions* 452 • *Exercises* 454 • *Access Workbench Exercises* 456 • *Marcia's Dry Cleaning Case Questions* 456 • *Garden Glory Project Questions* 458 • *James River Jewelry Project Questions (See Online Appendix D)* 459 • *The Queen Anne Curiosity Shop Project Questions* 460

8 Big Data, Data Warehouses, and Business Intelligence Systems 461
BUSINESS INTELLIGENCE SYSTEMS 463
THE RELATIONSHIP BETWEEN OPERATIONAL AND BI SYSTEMS 463
REPORTING SYSTEMS AND DATA MINING APPLICATIONS 464
DATA WAREHOUSES AND DATA MARTS 465
OLAP 474
DISTRIBUTED DATABASE PROCESSING 479
OBJECT-RELATIONAL DATABASES 482
BIG DATA AND THE NOT ONLY SQL MOVEMENT 482
THE ACCESS WORKBENCH SECTION 8—BUSINESS INTELLIGENCE SYSTEMS USING MICROSOFT ACCESS 487
Summary 500 • *Key Terms* 501 • *Review Questions* 501 • *Exercises* 503 • *Access Workbench Exercises* 504 • *Marcia's Dry Cleaning Case Questions* 505 • *Garden Glory Project Questions* 506 • *James River Jewelry Project Questions (See Online Appendix D)* 506 • *The Queen Anne Curiosity Shop Project Questions* 507

Glossary 511

Index 519

ONLINE APPENDICES: SEE PAGE 509 FOR INSTRUCTIONS

Appendix A: Getting Started with Microsoft SQL Server 2014 Express Edition

Appendix B: Getting Started with Oracle Database Express Edition 11*g* Release 2

Appendix C: Getting Started with MySQL 5.6 Community Server

Appendix D: James River Jewelry Project Questions

Appendix E: SQL Views, SQL/PSM, and Importing Data

Appendix F: Getting Started in Systems Analysis and Design

Appendix G: Getting Started with Microsoft Visio 2013

Appendix H: The Access Workbench—Section H—Microsoft Access 2013 Switchboards

Appendix I: Getting Started with Web Servers, PHP, and the NetBeans IDE

Appendix J: Business Intelligence Systems

Appendix K: Big Data