THIRTEENTH EDITION

MODERN DATABASE MANAGEMENT

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MODERN DATABASE MANAGEMENT

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—H.T.

BRIEF CONTENTS

Part I The Context of Database Management 1

Chapter 1 The Database Environment and Development Process 3

Part II Database Analysis and Logical Design 53

Chapter 2 Modeling Data in the Organization 55
Chapter 3 The Enhanced E-R Model 115
Chapter 4 Logical Database Design and the Relational Model 153

Part III Database Implementation and Use 205

Chapter 5 Introduction to SQL 207
Chapter 6 Advanced SQL 251
Chapter 7 Databases in Applications 297
Chapter 8 Physical Database Design and Database Infrastructure 333

Part IV Advanced Database Topics 385

Chapter 9 Data Warehousing and Data Integration 387
Chapter 10 Big Data Technologies 444
Chapter 11 Analytics and Its Implications 474
Chapter 12 Data and Database Administration with Focus on Data Quality 503

Glossary of Acronyms 529
Glossary of Terms 531
Index 539

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Chapter 13 Distributed Databases 13-1
Chapter 14 Object-Oriented Data Modeling 14-1

Appendices

Appendix A Data Modeling Tools and Notation A-1
Appendix B Advanced Normal Forms B-1
Appendix C Data Structures C-1

CONTENTS

Preface xxv

Part I The Context of Database Management 1

An Overview of Part I 1

Chapter 1 The Database Environment and Development Process 3

Learning Objectives 3

Data Matter! 4

Introduction 5

Basic Concepts and Definitions 6

Data 6

Data versus Information 7

Metadata 8

Traditional File Processing Systems 9

File Processing Systems at Pine Valley Furniture Company 9

Disadvantages of File Processing Systems 10

Program-Data Dependence 10

Duplication of Data 10

Limited Data Sharing 10

Lengthy Development Times 10

Excessive Program Maintenance 11

The Database Approach 11

Data Models 11

Entities 11

Relationships 11

Relational Databases 12

Database Management Systems 13

Advantages of the Database Approach 13

Program-Data Independence 13

Planned Data Redundancy 14

Improved Data Consistency 14

Improved Data Sharing 14

Increased Productivity of Application Development 14

Enforcement of Standards 15

Improved Data Quality 15

Improved Data Accessibility and Responsiveness 15

Reduced Program Maintenance 16

Improved Decision Support 16

Cautions about Database Benefits 16

Costs and Risks of the Database Approach 16

New, Specialized Personnel 16

Installation and Management Cost and Complexity 17

Conversion Costs 17

Need for Explicit Backup and Recovery 17

Organizational Conflict 17

Integrated Data Management Framework 17

Components of the Database Environment 18

The Database Development Process 20
Systems Development Life Cycle 21
PLANNING—ENTERPRISE MODELING 21
PLANNING—CONCEPTUAL DATA MODELING 21
ANALYSIS—CONCEPTUAL DATA MODELING 22
DESIGN—LOGICAL DATABASE DESIGN 23
DESIGN—PHYSICAL DATABASE DESIGN AND DEFINITION 23
IMPLEMENTATION—DATABASE IMPLEMENTATION 23
MAINTENANCE—DATABASE MAINTENANCE 24
Alternative Information Systems Development Approaches 24
Three-Schema Architecture for Database Development 25
Managing the People Involved in Database Development 27
Evolution of Database Systems 27
1960s 29
1970s 29
1980s 29
1990s 30
2000 and Beyond 30
The Range of Database Applications 30
Personal Databases 31
Departmental Multi-Tiered Client/Server Databases 31
Enterprise Applications 32
ENTERPRISE SYSTEMS 32
DATA WAREHOUSES 33
DATA LAKE 34
Developing a Database Application for Pine Valley Furniture Company 35
Database Evolution at Pine Valley Furniture Company 36
Project Planning 36
Analyzing Database Requirements 37
Designing the Database 40
Using the Database 42
Administering the Database 43
Future of Databases at Pine Valley 43
Summary 44 • Key Terms 45 • Review Questions 45 • Problems and Exercises 46 • Field Exercises 48 • References 49 • Further Reading 49 • Web Resources 50
▶ **CASE: Forondo Artist Management Excellence Inc. 51**

Part II Database Analysis and Logical Design 53
An Overview of Part II 53

Chapter 2 Modeling Data in the Organization 55
Learning Objectives 55
Introduction 55
The E-R Model: An Overview 58
Sample E-R Diagram 58
E-R Model Notation 60
Modeling the Rules of the Organization 61

Overview of Business Rules 62
The Business Rules Paradigm 62
Scope of Business Rules 63
Good Business Rules 63
Gathering Business Rules 64
Data Names and Definitions 64
Data Names 64
Data Definitions 65
Good Data Definitions 65
Modeling Entities and Attributes 67
Entities 67
Entity Type versus Entity Instance 67
Entity Type versus System Input, Output, or User 67
Strong versus Weak Entity Types 68
Naming and Defining Entity Types 69
Attributes 71
Required versus Optional Attributes 71
Simple versus Composite Attributes 72
Single-valued versus Multivalued Attributes 72
Stored versus Derived Attributes 73
Identifier Attribute 73
Naming and Defining Attributes 74
Modeling Relationships 76
Basic Concepts and Definitions in Relationships 77
Attributes on Relationships 78
Associative Entities 78
Degree of a Relationship 80
Unary Relationship 81
Binary Relationship 82
Ternary Relationship 82
Attributes or Entity? 83
Cardinality Constraints 85
Minimum Cardinality 85
Maximum Cardinality 86
Some Examples of Relationships and Their Cardinalities 86
A Ternary Relationship 87
Modeling Time-Dependent Data 88
Modeling Multiple Relationships Between Entity Types 90
Naming and Defining Relationships 92
E-R Modeling Example: Pine Valley Furniture Company 93
Database Processing At Pine Valley Furniture 96
Showing Product Information 96
Showing Product Line Information 96
Showing Customer Order Status 97
Showing Product Sales 98
Summary 99 • Key Terms 100 • Review Questions 100 • Problems and Exercises 101 • Field Exercises 111 • References 112 • Further Reading 112 • Web Resources 112
▶ **CASE: Forondo Artist Management Excellence Inc. 113**

Chapter 3 The Enhanced E-R Model 115

Learning Objectives 115
Introduction 115
Representing Supertypes and Subtypes 116
Basic Concepts and Notation 117
An Example of a Supertype/Subtype Relationship 118
Attribute Inheritance 119
When to Use Supertype/Subtype Relationships 119
Representing Specialization and Generalization 120
Generalization 120
Specialization 121
Combining Specialization and Generalization 122
Specifying Constraints in Supertype/Subtype Relationships 123
Specifying Completeness Constraints 123
Total Specialization Rule 123
Partial Specialization Rule 123
Specifying Disjointness Constraints 124
Disjoint Rule 124
Overlap Rule 125
Defining Subtype Discriminators 125
Disjoint Subtypes 125
Overlapping Subtypes 126
Defining Supertype/Subtype Hierarchies 127
An Example of a Supertype/Subtype Hierarchy 128
Summary of Supertype/Subtype Hierarchies 128
EER Modeling Example: Pine Valley Furniture Company 128
Entity Clustering 132
Packaged Data Models 135
A Revised Data Modeling Process with Packaged Data Models 137
Packaged Data Model Examples 139
Summary 144 • Key Terms 145 • Review Questions 145 • Problems and Exercises 146 • Field Exercises 149 • References 149 • Further Reading 150 • Web Resources 150
▶ **CASE: Forondo Artist Management Excellence Inc. 151**

Chapter 4 Logical Database Design and the Relational Model 153

Learning Objectives 153
Introduction 153
The Relational Data Model 154
Basic Definitions 154
Relational Data Structure 155
Relational Keys 155
Properties of Relations 156
Removing Multivalued Attributes from Tables 156
Sample Database 157
Integrity Constraints 158
Domain Constraints 158
Entity Integrity 158
Referential Integrity 160

Creating Relational Tables 161
Well-Structured Relations 162
Transforming EER Diagrams into Relations 163
Step 1: Map Regular Entities 164
Composite Attributes 164
Multivalued Attributes 165
Step 2: Map Weak Entities 165
When to Create a Surrogate Key 166
Step 3: Map Binary Relationships 167
Map Binary One-to-Many Relationships 167
Map Binary Many-to-Many Relationships 168
Map Binary One-to-One Relationships 168
Step 4: Map Associative Entities 169
Identifier not Assigned 169
Identifier Assigned 170
Step 5: Map Unary Relationships 171
Unary One-to-Many Relationships 171
Unary Many-to-Many Relationships 172
Step 6: Map Ternary (and *n*-ary) Relationships 173
Step 7: Map Supertype/Subtype Relationships 174
Summary of EER-to-Relational Transformations 176
Introduction to Normalization 176
Steps in Normalization 177
Functional Dependencies and Keys 177
Determinants 179
Candidate Keys 179
Normalization Example: Pine Valley Furniture Company 180
Step 0: Represent the View in Tabular Form 180
Step 1: Convert to First Normal Form 181
Remove Repeating Groups 181
Select the Primary Key 182
Anomalies in 1NF 182
Step 2: Convert to Second Normal Form 183
Step 3: Convert to Third Normal Form 184
Removing Transitive Dependencies 184
Determinants and Normalization 185
Step 4: Further Normalization 185
Merging Relations 186
An Example 186
View Integration Problems 186
Synonyms 187
Homonyms 187
Transitive Dependencies 187
Supertype/Subtype Relationships 188
A Final Step for Defining Relational Keys 188
Summary 191 • Key Terms 191 • Review Questions 191 • Problems and Exercises 192 • Field Exercises 201 • References 202 • Further Reading 202 • Web Resources 202
▶ **CASE: Forondo Artist Management Excellence Inc. 203**

Part III Database Implementation and Use 205

An Overview of Part III 205

Chapter 5 Introduction to SQL 207

Learning Objectives 207
Introduction 207
Origins of the SQL Standard 209
The SQL Environment 211
SQL Data Types 213
Defining A Database in SQL 216
Generating SQL Database Definitions 216
Creating Tables 217
Creating Data Integrity Controls 220
Changing Table Definitions 221
Removing Tables 221
Inserting, Updating, and Deleting Data 222
Batch Input 223
Deleting Database Contents 223
Updating Database Contents 224
Internal Schema Definition in RDBMSs 225
Creating Indexes 225
Processing Single Tables 226
Clauses of the SELECT Statement 226
Using Expressions 228
Using Functions 229
Using Wildcards 232
Using Comparison Operators 232
Using Null Values 233
Using Boolean Operators 233
Using Ranges for Qualification 236
Using Distinct Values 236
Using IN and NOT IN with Lists 238
Sorting Results: The ORDER BY Clause 239
Categorizing Results: The GROUP BY Clause 240
Qualifying Results by Categories: The HAVING Clause 241
Summary 243 • Key Terms 243 • Review Questions 243 • Problems and Exercises 244 • Field Exercises 248 • References 248 • Further Reading 249 • Web Resources 249

▶ CASE: Forondo Artist Management Excellence Inc. 250

Chapter 6 Advanced SQL 251

Learning Objectives 251
Introduction 251
Processing Multiple Tables 252
Equi-Join 253
Natural Join 254
Outer Join 255
Sample Join Involving Four Tables 257

Self-Join 258
Subqueries 260
Correlated Subqueries 265
Using Derived Tables 267
Combinings Queries 267
Conditional Expressions 269
More Complicated SQL Queries 270
Tips for Developing Queries 272
Guidelines for Better Query Design 274
Using and Defining Views 275
Materialized Views 279
Triggers and Routines 279
Triggers 280
Routines and Other Programming Extensions 282
Example Routine in Oracle's PL/SQL 284
Data Dictionary Facilities 285
Recent Enhancements and Extensions to SQL 287
Analytical and OLAP Functions 287
New Temporal Features in SQL 288
Other Enhancements 288
Summary 289 • Key Terms 290 • Review Questions 290 • Problems and Exercises 291 • Field Exercises 294 • References 294 • Further Reading 295 • Web Resources 295
▶ **CASE: Forondo Artist Management Excellence Inc. 296**

Chapter 7 Databases in Applications 297
Learning Objectives 297
Location, Location, Location! 297
Introduction 298
Client/Server Architectures 298
Databases in Three-Tier Applications 302
A Java Web Application 303
A Python Web Application 307
Key Considerations in Three-Tier Applications 313
Stored Procedures 313
Transactions 313
Database Connections 315
Key Benefits of Three-Tier Applications 315
Transaction Integrity 316
Controlling Concurrent Access 318
The Problem of Lost Updates 318
Serializability 319
Locking Mechanisms 319
Locking Level 319
Types of Locks 320
Deadlock 321
Managing Deadlock 321
Versioning 322

Managing Data Security in an Application Context 324
Threats to Data Security 324
Establishing Client/Server Security 325
Server Security 326
Network Security 326
Application Security Issues in Three-Tier Client/Server Environments 326
Data Privacy 327
Summary 329 • Key Terms 329 • Review Questions 329 • Problems and Exercises 330 • Field Exercises 331 • References 331 • Further Reading 331 • Web Resources 331
▶ CASE: Forondo Artist Management Excellence Inc. 332

Chapter 8 Physical Database Design and Database Infrastructure 333
Learning Objectives 333
Introduction 334
The Physical Database Design Process 335
Who Is Responsible for Physical Database Design? 335
Physical Database Design as a Basis for Regulatory Compliance 336
SOX and Databases 337
IT Change Management 337
Logical Access to Data 337
IT Operations 338
Data Volume and Usage Analysis 338
Designing Fields 340
Choosing Data Types 340
Coding Techniques 341
Controlling Data Integrity 342
Handling Missing Data 343
Denormalizing and Partitioning Data 343
Denormalization 343
Opportunities for and Types of Denormalization 344
Denormalize with Caution 345
Partitioning 347
Designing Physical Database Files 348
File Organizations 350
Heap File Organization 350
Sequential File Organizations 350
Indexed File Organizations 352
Hashed File Organizations 353
Clustering Files 353
Designing Controls for Files 354
Using and Selecting Indexes 354
Creating a Unique Key Index 354
Creating a Secondary (Nonunique) Key Index 355
When to Use Indexes 355
Designing a Database for Optimal Query Performance 356
Parallel Query Processing 357
Overriding Automatic Query Optimization 358
Data Dictionaries and Repositories 358

Data Dictionary 359
Repositories 359
Database Software Data Security Features 361
Views 361
Integrity Controls 362
Authorization Rules 363
User-Defined Procedures 365
Encryption 365
Authentication Schemes 365
PASSWORDS 366
STRONG AUTHENTICATION 366
Database Backup and Recovery 367
Basic Recovery Facilities 367
BACKUP FACILITIES 367
JOURNALIZING FACILITIES 368
CHECKPOINT FACILITY 368
RECOVERY MANAGER 369
Recovery and Restart Procedures 369
DISK MIRRORING 369
RESTORE/RERUN 370
BACKWARD RECOVERY 370
FORWARD RECOVERY 371
Types of Database Failure 371
ABORTED TRANSACTIONS 372
INCORRECT DATA 372
SYSTEM FAILURE 372
DATABASE DESTRUCTION 372
Disaster Recovery 373
Cloud-Based Database Infrastructure 373
Cloud-Based Models for Providing Data Management Services 373
Benefits and Downsides of Using Cloud-Based Data Management Services 374
Summary 375 • Key Terms 376 • Review Questions 377 • Problems and Exercises 378 • Field Exercises 382 • References 383 • Further Reading 383 • Web Resources 383
▶ **CASE: Forondo Artist Management Excellence Inc. 384**

Part IV Advanced Database Topics 385
An Overview of Part IV 385

Chapter 9 Data Warehousing and Data Integration 387
Learning Objectives 387
Introduction 387
Basic Concepts of Data Warehousing 390
A Brief History of Data Warehousing 390
The Need for Data Warehousing 390
NEED FOR A COMPANY-WIDE VIEW 390
NEED TO SEPARATE OPERATIONAL AND INFORMATIONAL SYSTEMS 393
Data Warehouse Architectures 393

Independent Data Mart Data Warehousing Environment 394
Dependent Data Mart and Operational Data Store Architecture: A Three-Level Approach 395
Logical Data Mart and Real-Time Data Warehouse Architecture 397
Three-Layer Data Architecture 400
Role of the Enterprise Data Model 400
Role of Metadata 400
Some Characteristics of Data Warehouse Data 401
Status versus Event Data 401
Transient versus Periodic Data 402
An Example of Transient and Periodic Data 402
Transient Data 404
Periodic Data 404
Other Data Warehouse Changes 404
The Derived Data Layer 405
Characteristics of Derived Data 405
The Star Schema 406
Fact Tables and Dimension Tables 406
Example Star Schema 407
Surrogate Key 408
Grain of the Fact Table 409
Duration of the Database 410
Size of the Fact Table 410
Modeling Date and Time 411
Variations of the Star Schema 412
Multiple Fact Tables 412
Factless Fact Tables 413
Normalizing Dimension Tables 414
Multivalued Dimensions 414
Hierarchies 415
Slowly Changing Dimensions 417
Determining Dimensions and Facts 420
Data Integration: An Overview 422
General Approaches to Data Integration 422
Data Federation 423
Data Propagation 423
Data Integration for Data Warehousing: The Reconciled Data Layer 424
Characteristics of Data after ETL 424
The ETL Process 425
Mapping and Metadata Management 425
Extract 426
Cleanse 427
Load and Index 429
Data Transformation 430
Data Transformation Functions 431
Record-Level Functions 431
Field-Level Functions 432
Data Warehouse Administration 434

The Future of Data Warehousing: Integration with Other Forms of Data Management and Analytics 434
Speed of Processing 435
Moving the Data Warehouse into the Cloud 435
Dealing with Unstructured Data 436
Summary 436 • Key Terms 437 • Review Questions 437 • Problems and Exercises 438 • Field Exercises 442 • References 442 • Further Reading 443 • Web Resources 443

Chapter 10 Big Data Technologies 444
Learning Objectives 444
Introduction 444
Moving Beyond Transactional and Data Warehousing Databases 446
Big Data 446
NoSQL 448
Classification of NoSQL DBMSs 450
Key-Value Stores 450
Document Stores 451
Wide-Column Stores 451
Graph-Oriented Databases 451
NoSQL Examples 451
Redis 451
MongoDB 452
Apache Cassandra 452
Neo4j 452
A NoSQL Example: MongoDB 452
Documents 452
Collections 454
Relationships 454
Querying MongoDB 455
Impact of NoSQL on Database Professionals 456
Hadoop 458
Components of Hadoop 459
The Hadoop Distributed File System (HDFS) 459
MapReduce 459
Pig 461
Hive 461
HBase 462
A Practical Introduction to Pig 462
Loading Data 462
Transforming Data 463
A Practical Introduction to Hive 465
Creating a Table 465
Loading Data into the Table 465
Processing the Data 466
Integrated Analytics and Data Science Platforms 466
HP HAVEn 466
Teradata Aster 467
IBM Big Data Platform 469

Putting It All Together: Integrated Data Architecture 469
Summary 471 • Key Terms 471 • Review Questions 471 • Problems and Exercises 472 • References 472 • Further Reading 473 • Web Resources 473

Chapter 11 Analytics and Its Implications 474
Learning Objectives 474
Introduction 474
Analytics 475
Types of Analytics 475
Use of Descriptive Analytics 477
SQL OLAP Querying 478
OLAP Tools 480
Data Visualization 482
Business Performance Management and Dashboards 483
Use of Predictive Analytics 484
Data Mining Tools 485
Examples of Predictive Analytics 486
Use of Prescriptive Analytics 487
Key User Tools for Analytics 488
Analytical and OLAP Functions 489
R 490
Python 491
Apache Spark 492
Data Management Infrastructure for Analytics 493
Impact of Big Data and Analytics 495
Applications of Big Data and Analytics 495
Business 496
E-Government and Politics 496
Science and Technology 496
Smart Health and Well-Being 497
Security and Public Safety 497
Implications of Big Data Analytics and Decision Making 497
Personal Privacy versus Collective Benefits 498
Ownership and Access 498
Quality and Reuse of Data and Algorithms 498
Transparency and Validation 498
Changing Nature of Work 499
Demands for Workforce Capabilities and Education 499
Summary 499 • Key Terms 500 • Review Questions 500 • Problems and Exercises 500 • References 501 • Further Reading 502

Chapter 12 Data and Database Administration with Focus on Data Quality 503
Learning Objectives 503
Introduction 503
Overview of Data and Database Administration 505
Data Administration 505
Database Administration 506

Traditional Database Administration 506
Trends in Database Administration 508
Evolving Data Administration Roles 510
The Open Source Movement and Database Management 511
Data Governance 512
Managing Data Quality 513
Characteristics of Quality Data 514
External Data Sources 515
Redundant Data Storage and Inconsistent Metadata 516
Data Entry Problems 516
Lack of Organizational Commitment 516
Data Quality Improvement 516
Get the Business Buy-In 516
Conduct a Data Quality Audit 517
Establish a Data Stewardship Program 518
Improve Data Capture Processes 518
Apply Modern Data Management Principles and Technology 519
Apply TQM Principles and Practices 519
Summary of Data Quality 519
Data Availability 520
Costs of Downtime 520
Measures to Ensure Availability 521
Hardware Failures 521
Loss or Corruption of Data 521
Human Error 521
Maintenance Downtime 521
Network-Related Problems 521
Master Data Management 521
Summary 523 • Key Terms 523 • Review Questions 524 • Problems and Exercises 524 • Field Exercises 526 • References 526 • Further Reading 527 • Web Resources 527

Glossary of Acronyms 529
Glossary of Terms 531
Index 539

ONLINE CHAPTERS

Chapter 13 Distributed Databases 13-1

Learning Objectives 13-1
Introduction 13-1
Objectives and Trade-Offs 13-4
Options for Distributing a Database 13-6
Data Replication 13-6
Snapshot Replication 13-7
Near-Real-Time Replication 13-8
Pull Replication 13-8
Database Integrity with Replication 13-8
When to Use Replication 13-9
Horizontal Partitioning 13-9
Vertical Partitioning 13-10
Combinations of Operations 13-11
Selecting the Right Data Distribution Strategy 13-12
Distributed DBMS 13-13
Location Transparency 13-15
Replication Transparency 13-16
Failure Transparency 13-17
Commit Protocol 13-17
Concurrency Transparency 13-18
Time Stamping 13-19
Query Optimization 13-19
Evolution of Distributed DBMSs 13-22
Remote Unit of Work 13-22
Distributed Unit of Work 13-22
Distributed Request 13-23
Summary 13-23 • Key Terms 13-24 • Review Questions 13-24 • Problems and Exercises 13-25 • Field Exercises 13-27 • References 13-27 • Further Reading 13-27 • Web Resources 13-27

Chapter 14 Object-Oriented Data Modeling 14-1

Learning Objectives 14-1
Introduction 14-1
Unified Modeling Language 14-3
Object-Oriented Data Modeling 14-4
Representing Objects and Classes 14-4
Types of Operations 14-7
Representing Associations 14-7
Representing Association Classes 14-11
Representing Derived Attributes, Derived Associations, and Derived Roles 14-12
Representing Generalization 14-13
Interpreting Inheritance and Overriding 14-18

Representing Multiple Inheritance 14-19
Representing Aggregation 14-19
Business Rules 14-22
Object Modeling Example: Pine Valley Furniture Company 14-23
Summary 14-25 • Key Terms 14-26 • Review Questions 14-26 • Problems and Exercises 14-30 • Field Exercises 14-37 • References 14-37 • Further Reading 14-38 • Web Resources 14-38

Appendix A Data Modeling Tools and Notation A-1
Comparing E-R Modeling Conventions A-1
Visio Professional 2016 Notation A-1
ENTITIES A-5
RELATIONSHIPS A-5
CA ERwin Data Modeler 9.7 Notation A-5
ENTITIES A-5
RELATIONSHIPS A-5
SAP Sybase PowerDesigner 16.6 Notation A-7
ENTITIES A-8
RELATIONSHIPS A-8
Oracle Designer Notation A-8
ENTITIES A-8
RELATIONSHIPS A-8
Comparison of Tool Interfaces and E-R Diagrams A-8

Appendix B Advanced Normal Forms B-1
Boyce-Codd Normal Form B-1
Anomalies in Student Advisor B-1
Definition of Boyce-Codd Normal Form (BCNF) B-2
Converting a Relation to BCNF B-2
Fourth Normal Form B-3
Multivalued Dependencies B-5
Higher Normal Forms B-5
Key Terms B-6 • References B-6 • Web Resources B-6

Appendix C Data Structures C-1
Pointers C-1
Data Structure Building Blocks C-2
Linear Data Structures C-4
Stacks C-5
Queues C-5
Sorted Lists C-6
Multilists C-8
Hazards of Chain Structures C-8
Trees C-9
Balanced Trees C-9
References C-12

PREFACE

This text is designed for introductory courses in database management. Such a course is usually required as part of an information systems curriculum in business schools, computer technology programs, and applied computer science departments. The Association for Information Systems (AIS), the Association for Computing Machinery (ACM), and the International Federation of Information Processing Societies (IFIPS) curriculum guidelines (e.g., IS 2010 and MSIS 2016) all outline this type of database management course or the competencies a student completing the course is expected to have. Previous editions of this text have been used successfully for more than 35 years at both the undergraduate and graduate levels as well as in management and professional development programs.

WHAT'S NEW IN THIS EDITION?

This 13th edition of *Modern Database Management* updates and expands materials in areas undergoing rapid change as a result of improved managerial practices, database design tools and methodologies, and database technology. Later, we detail changes to each chapter. The themes of this 13th edition reflect the major trends in the information systems field and the skills required of modern information systems graduates. The most important changes are as follows:

- The book has been restructured in several important ways. Chapter 7 on databases in applications now also includes segments on transaction integrity, designing multi-user solutions, and application level security, bringing these important perspectives together with their context. The revised chapter on physical database design and database infrastructure (new Chapter 8) includes also coverage of database security, backup and recovery, cloud-based database solutions, and other essential database infrastructure topics. This new comprehensive structure on physical design and infrastructure is now placed after the SQL chapters. The new version of Chapter 9 integrates material on data warehousing and data integrity in a conceptually natural pairing. Recognizing the way in which analytics capabilities rely on all types of data management solutions, Chapter 11, on analytics and implications, is now separate from Chapter 10, on big data. Finally, Chapter 12 brings together data and database administration with data quality, emphasizing the essential connections between the three.
- The part structure of the book has been redesigned to be fully aligned with the new chapter structure.
- We have introduced a new overarching framework (Figure 1-5), which gives our readers a clearer overview of structure of the book and its core topic areas. The framework communicates clearly the increasing importance of informational systems (divided into Analytics–Data Warehousing and Analytics–Big Data) in addition to this book's traditional strength of transactional systems.
- Given the continued and still increasing interest in big data and analytics, we have continued to expand content in this area. The book has now separate chapters on big data technologies (Chapter 10) and analytics (Chapter 11). In addition to general coverage of NoSQL and Hadoop technologies, Chapter 10 provides also detailed examples of MongoDB, Pig, and Hive. Chapter 11 includes extended coverage of R, Python, and Apache Spark—all essential technologies for analytics professionals that allow a link between analytics and data management architectures.
- We emphasize the increasing importance of cloud-based database solutions, mobile technologies, and agile development throughout the book.
- Chapter 1 now better recognizes the broad range of enterprise level applications data management solutions enable and support, including enterprise systems, data warehouses, and data lakes.

- Chapter 7 on databases in applications now includes an extensive example demonstrating the use of Python in the context of database-driven applications.
- The instructor's manual will have more material to support the case Forondo Artist Management Excellence that was introduced in the 12th edition.

In addition to the new topics covered, specific improvements to the textbook have been made in the following areas:

- Every chapter went through significant edits to streamline coverage to ensure relevance with current technologies and eliminate redundancies.
- The entire book has been edited so that its language clearly reflects its focus on the readers as learners instead of authors as teachers
- End-of-chapter material (review questions, problems and exercises, and/or field exercises) in every chapter has been revised with new and modified questions and exercises.
- We continued to update the figures in several chapters to reflect the changing landscape of technologies that are being used in modern organizations.
- The Web Resources section in each chapter was updated to ensure that students have information on the latest database trends and expanded background details on important topics covered in the text.
- The book continues to be available through VitalSource, an innovative e-book delivery system, and as an electronic book in the Kindle format.

Also, we continue to provide on the student Companion Web site several custom-developed short videos that address key concepts and skills from different sections of the book. These videos, produced by the textbook authors, help students learn difficult material by using both the printed text and a mini-lecture or tutorial. Videos have been developed to support Chapters 1 (introduction to database), 2 and 3 (conceptual data modeling), 4 (normalization), and 6 and 7 (SQL). Look for special icons on the opening page of these chapters to call attention to these videos, and go to **www.pearsonhighered.com/hoffer** to find these videos.

FOR THOSE NEW TO *MODERN DATABASE MANAGEMENT*

Modern Database Management has been a leading text since its first edition in 1983. In spite of this market leadership position, some instructors have used other good database management texts. Why might you want to switch at this time? There are several good reasons:

- One of our goals, in every edition, has been to lead other books in coverage of the latest principles, concepts, and technologies. See what we have added for the 13th edition in "What's New in This Edition?" In the past, we have led in coverage of object-oriented data modeling and UML, Internet databases, data warehousing, and the use of CASE tools in support of data modeling. For the 13th edition, we continue this tradition by continuing to expand and improve coverage of big data and analytics, focusing on what every database student needs to understand about these topics.
- While remaining current, this text focuses on what leading practitioners say is most important for database developers. We work with many practitioners, including the professionals of the Data Management Association (DAMA) and The Data Warehousing Institute (TDWI), leading consultants, technology leaders, and authors of articles in the most widely read professional publications. We draw on these experts to ensure that what the book includes is important and covers not only important entry-level knowledge and skills but also those fundamentals and mind-sets that lead to long-term career success.
- In the 13th edition of this highly successful book, material is presented in a way that has been viewed as very accessible to students. Our methods have been refined through continuous market feedback for more than 35 years as well as through our own teaching. Overall, the pedagogy of the book is sound, and we believe that the new framework that we introduced in Chapter 1 will further strengthen our students'

understanding of the big picture of data management. We use many illustrations that help make important concepts and techniques clear. We use the most modern notations. The organization of the book is flexible, so you can use chapters in whatever sequence makes sense for your students. We supplement the book with data sets to facilitate hands-on, practical learning and with new media resources to make some of the more challenging topics more engaging.

- Our text can accommodate structural flexibility. For example, you may have particular interest in introducing SQL early in your course. Our text makes this possible. First, we cover SQL in depth, devoting two full chapters to this core technology of the database field. Second, we include many SQL examples in early chapters. Third, many instructors have successfully used the two SQL chapters early in their course. Although logically appearing in the life cycle of systems development as Chapters 5 and 6, part of the implementation section of the text, many instructors have used these chapters immediately after Chapter 1 or in parallel with other early chapters. Finally, we use SQL throughout the book, for example, to illustrate Web application connections to relational databases in Chapter 7 and online analytical processing in Chapter 11.
- We have the latest in supplements and Web site support for the text. See the supplement package for details on all the resources available to you and your students.
- This text is written to be part of a modern information systems curriculum with a strong business systems development focus. Topics are included and addressed so as to reinforce principles from other typical courses, such as systems analysis and design, networking, Web site design and development, MIS principles, and application development. Emphasis is on the development of the database component of modern information systems and on the management of the data resource. Thus, the text is practical, supports projects and other hands-on class activities, and encourages linking database concepts to concepts being learned throughout the curriculum the student is taking.

SUMMARY OF ENHANCEMENTS TO EACH CHAPTER

The following sections present a chapter-by-chapter description of the major changes in this edition. Each chapter description presents a statement of the purpose of that chapter, followed by a description of the changes and revisions that have been made for the 13th edition. Each paragraph concludes with a description of the strengths that have been retained from prior editions.

PART I: THE CONTEXT OF DATABASE MANAGEMENT

Chapter 1: The Database Environment and Development Process

This chapter discusses the role of databases in organizations and previews the major topics in the remainder of the text. The primary change to this chapter has been the introduction of a new integrated data management framework (Figure 1-5) and supporting text accompanying it. This framework recognizes the increasing importance of the *informational* systems in addition to the traditional focus of this book on *transactional* systems. After presenting a brief introduction to the basic terminology associated with storing and retrieving data, the chapter presents a well-organized comparison of traditional file processing systems and modern database technology. The chapter then introduces the core components of a database environment. It then goes on to explain the process of database development in the context of structured life cycle, prototyping, and agile methodologies. The chapter also discusses important issues in database development, including management of the diverse group of people involved in database development and frameworks for understanding database architectures and technologies (e.g., the three-schema architecture). Reviewers frequently note the compatibility of this chapter with what students learn in systems analysis and design classes. A brief history of the evolution of database technology, from pre-database files to modern object-relational technologies, is presented. The chapter also provides

an overview of the range of database applications that are currently in use within organizations—personal, multi-tier, and enterprise applications. The explanation of enterprise databases includes databases that are part of enterprise resource planning systems and data warehouses. The chapter concludes with a description of the process of developing a database in a fictitious company, Pine Valley Furniture. This description closely mirrors the steps in database development described earlier in the chapter. The first chapter provides an introduction to the FAME case, which then continues through the book until Chapter 8.

PART II: DATABASE ANALYSIS AND LOGICAL DESIGN

Chapter 2: Modeling Data in the Organization

This chapter presents a thorough introduction to conceptual data modeling with the entity-relationship (E-R) model. The chapter title emphasizes the reason for the E-R model: to unambiguously document the rules of the business that influence database design. Specific subsections explain in detail how to name and define elements of a data model, which are essential in developing an unambiguous E-R diagram. The chapter continues to proceed from simple to more complex examples, and it concludes with a comprehensive E-R diagram for the Pine Valley Furniture Company. In the 13th edition, we have provided six new problems and exercises; these new exercises present some more modern situations, such as Internet of Things applications for databases. A variety of other problems and exercises as well as review questions have been changed to emphasize important topics of the chapter. Appendix A provides information on different data modeling tools and notations.

Chapter 3: The Enhanced E-R Model

This chapter presents a discussion of several advanced E-R data model constructs, primarily supertype/subtype relationships. As in Chapter 2, problems and exercises have been revised, with three new exercises and several building on or extending the new exercises from Chapter 2. The third part of the new FAME case is presented in this chapter. The chapter continues to present thorough coverage of supertype/subtype relationships and includes a comprehensive example of an extended E-R data model for the Pine Valley Furniture Company.

Chapter 4: Logical Database Design and the Relational Model

This chapter describes the process of converting a conceptual data model to the relational data model, as well as how to merge new relations into an existing normalized database. It provides a conceptually sound and practically relevant introduction to normalization, emphasizing the importance of the use of functional dependencies and determinants as the basis for normalization. Concepts of normalization and normal forms are extended in Appendix B. The chapter features a discussion of the characteristics of foreign keys and introduces the important concept of a nonintelligent enterprise key. Enterprise keys (also called surrogate keys for data warehouses) are emphasized as some concepts of object-orientation have migrated into the relational technology world. New problems and exercises are included that draw upon the new problems and exercises from Chapters 2 and 3 for relational modeling and normalization. The chapter continues to emphasize the basic concepts of the relational data model and the role of the database designer in the logical design process.

PART III: DATABASE IMPLEMENTATION AND USE

Chapter 5: Introduction to SQL

This chapter (Chapter 6 in 12th edition) presents a thorough introduction to the SQL used by most DBMSs (SQL:1999) and introduces the changes that are included in the latest standards (SQL: 2011 and SQL:2016). This edition adds coverage of the new features of SQL:2016, including row pattern recognition, JSON support, and extended analytical

capabilities. The new edition also clarifies coverage of SQL data types and, overall, makes it easier to move from relational design in Chapter 4 directly to database implementation without the material on physical database design (now in Chapter 8). The coverage of SQL is extensive and divided between this chapter and Chapter 6. This chapter includes examples of SQL code, using mostly SQL:1999 and SQL:2016 syntax, as well as some Oracle 12c and Microsoft SQL Server syntax. Some unique features of MySQL are mentioned. In this edition, coverage of views has been moved to Chapter 6. Chapter 5 explains the SQL commands needed to create and maintain a database and to program single-table queries. Five review questions and 13 problems and exercises have been added to the chapter or modified extensively. The chapter continues to use the Pine Valley Furniture Company case to illustrate a wide variety of practical queries and query results.

Chapter 6: Advanced SQL

This chapter (Chapter 7 in 12th edition) continues the description of SQL, with a careful explanation of multiple-table queries, transaction integrity, data dictionaries, dynamic and materialized views, triggers and stored procedures (the differences between them are now more clearly explained), and embedding SQL in other programming language programs. All forms of the OUTER JOIN command are covered. Standard SQL (with an updated focus on SQL:2016) is also used. The revised version of the chapter includes now thorough coverage of views and the purposes for which they are used, including their role in enabling security and privacy solutions. This chapter illustrates how to store the results of a query in a derived table, the CAST command to convert data between different data types, and the CASE command for doing conditional processing in SQL. Emphasis continues on the set-processing style of SQL compared with the record processing of programming languages with which the student may be familiar. The section on routines has been revised to provide clarified, expanded, and more current coverage of this topic. The material of transaction integrity, has, however been moved to Chapter 7, where it most naturally belongs. The chapter continues to contain a clear explanation of subqueries and correlated subqueries, two of the most complex and powerful constructs in SQL. At the end, the chapter discusses material that is new to this chapter: data dictionary facilities (in practice, using SQL to understand the structure of the database) and recent extensions and enhancements to SQL. Chapter review material has been updated with 13 new problems and exercises and three new review questions.

Chapter 7: Databases in Applications

This chapter (Chapter 8 in 12th edition) provides a modern discussion of the concepts of client/server architecture and applications, middleware, and database access in contemporary database environments. The chapter has been structurally significantly modified to provide additional clarity, including the integration of material on a two-tiered architecture into the section on three-tiered architecture. In addition to a revised example of writing a Java web application, there is an entire new section—including an extensive and detailed example—on writing Web applications with Python, a widely used general purpose programming language that has become very popular in analytics. Sections on transaction integrity, concurrent access, and application level data security have been revised and moved to this chapter to provide additional conceptual clarity. Material on cloud computing has been moved to Chapter 8 on database infrastructure. Review questions and problems and exercises have been updated.

Chapter 8: Physical Database Design and Database Infrastructure

This chapter (Chapter 5 in the 12th edition) describes the steps that are essential in achieving an efficient database design, with a strong focus on those aspects of database design and implementation that are typically within the control of a database professional in a modern database environment. In addition, several new topics on database infrastructure have been integrated into this chapter to improve the structural clarity of the book, including data dictionaries and repositories, general database software security features, and database backup and recovery. A revised and extended section on cloud-based database infrastructure completes the chapter. Overall, the chapter emphasizes ways to

improve database performance, with references to specific techniques available in Oracle and other DBMSs to achieve this goal. The discussion of indexes includes descriptions of the types of indexes that are widely available in database technologies as techniques to improve query processing speed. Appendix C provides excellent background on fundamental data structures for programs of study that need coverage of this topic. The chapter continues to emphasize the physical design process and the goals of that process. Review questions and problems and exercises have been updated and extended based on the new structure and content of the chapter.

PART IV: ADVANCED DATABASE TOPICS

Chapter 9: Data Warehousing and Data Integration

This chapter describes the basic concepts of data warehousing, the reasons data warehousing is regarded as critical to competitive advantage in many organizations, and the database design activities and structures unique to data warehousing. The most important change of this chapter is the integration of material on data integration (formerly in Chapter 10 in the 12th edition) into it. This change strengthens the readers' ability to understand the essential role of data integration in data warehousing (particularly in ETL and other aspects of data preparation), and it clarifies the structure of the book. Topics covered in this chapter include alternative data warehouse architectures and the dimensional data model (or star schema) for data warehouses. In this edition, additional attention is given to cloud-based implementation of data warehouses. Throughout the chapter, several details have been updated to ensure technical correctness. Operational data store and independent, dependent, and logical data marts are defined. The chapter includes multiple new and revised review questions and problems and exercises.

Chapter 10: Big Data Technologies

This chapter incorporates big data infrastructure material from Chapter 11 in the 12th edition, significantly expanding it and making it more directly applicable with substantial detailed descriptive examples of MongoDB (the most popular NoSQL database) and Pig (scripting language and task automation environment for Hadoop) and Hive (an SQL-like declarative language for querying data stored in Hadoop). This new version of the material gives the students a much more practical, hands-on sense of the purposes for which these well-known tools can be used and how they can serve the goals of big data management. The chapter also includes several new problems and exercises based on these environments. Overall, the chapter helps the readers understand how big data technologies have expanded the possibilities for analytics-driven innovation through advanced informational systems that are pushing boundaries further in terms of volume, velocity, and variety of data while paying continuous attention to value and veracity of big data.

Chapter 11: Analytics and its Implications

Chapter 11 offers integrated coverage of analytics, including descriptive, predictive, and prescriptive analytics. It is based on material on analytics in the big data and analytics chapter in the 12th edition, expanding it with comprehensive new sections on R, Python, and Apache Spark and bringing in material on analytical functions in SQL. The discussion on analytics is linked not only to the coverage of big data but also the material on data warehousing in Chapter 9 and the general discussion on data management in Chapter 1 (as indicated in the new framework in Chapter 1). The chapter also covers approaches and technologies used by analytics professionals, such as on-line analytical processing, data visualization, business performance management and dashboards, data mining, and text mining. Finally, the chapter integrates the coverage of big data and analytics technologies to the individual, organizational, and societal implications of these capabilities. Review questions on the new material have been added.

Chapter 12: Data and Database Administration with Focus on Data Quality

This chapter presents a thorough discussion of the importance and roles of data and database administration and describes a number of the key issues that arise when these functions are performed. This chapter emphasizes the changing roles and approaches of data and database administration, with a renewed and strengthened emphasis on data quality. The chapter both discusses essential characteristics of high-quality data and the mechanisms that organizations need to put in place to enable data quality improvement. Data governance, data availability, and master data management are also covered. The chapter continues to emphasize the critical importance of data and database management in managing data as a corporate asset.

Chapter 13: Distributed Databases

This chapter—available on the book's Web site—reviews the role, technologies, and unique database design opportunities of distributed databases. The objectives and trade-offs for distributed databases, data replication alternatives, factors in selecting a data distribution strategy, and distributed database vendors and products are covered. This chapter provides thorough coverage of database concurrency access controls. Many reviewers have indicated that they are seldom able to cover this chapter in an introductory course, but having the material available is critical for advanced students or special topics.

Chapter 14: Object-Oriented Data Modeling

This chapter presents an introduction to object-oriented modeling using Object Management Group's Unified Modeling Language (UML). This chapter has been carefully reviewed to ensure consistency with the latest UML notation and best industry practices. UML provides an industry-standard notation for representing classes and objects. The chapter continues to emphasize basic object-oriented concepts, such as inheritance, encapsulation, composition, and polymorphism. As with Chapter 13, Chapter 14 is available on the textbook's Web site.

APPENDICES

In the 13th edition three appendices are available on the book's Web site and are intended for those who wish to explore certain topics in greater depth.

Appendix A: Data Modeling Tools and Notation

This appendix addresses a need raised by many readers—how to translate the E-R notation in the text into the form used by the CASE tool or the DBMS used in class. Specifically, this appendix compares the notations of CA ERwin Data Modeler r9.7, Oracle SQL Data Modeler 4.2, SAP Sybase PowerDesigner 16.6, and Microsoft Visio Professional 2016. Tables and illustrations show the notations used for the same constructs in each of these popular software packages.

Appendix B: Advanced Normal Forms

This appendix presents a description (with examples) of Boyce-Codd and fourth normal forms, including an example of BCNF to show how to handle overlapping candidate keys. Other normal forms are briefly introduced. The Web Resources section includes a reference for information on many advanced normal form topics.

Appendix C: Data Structures

This appendix describes several data structures that often underlie database implementations. Topics include the use of pointers, stacks, queues, sorted lists, inverted lists, and trees.

PEDAGOGY

A number of additions and improvements have been made to end-of-chapter materials to provide a wider and richer range of choices for the user. The most important of these improvements are the following:

1. ***Review Questions*** Questions have been updated to support new and enhanced chapter material.
2. ***Problems and Exercises*** This section has been reviewed in every chapter, and many chapters contain new problems and exercises to support updated chapter material. Of special interest are questions in many chapters that give students opportunities to use the data sets provided for the text. Problems and exercises are presented in roughly increasing order of difficulty, which should help instructors and students find exercises appropriate for what they want to accomplish.
3. ***Field Exercises*** This section provides a set of "hands-on" mini-cases that can be assigned to individual students or to small teams of students. Field exercises range from directed field trips to Internet searches and other types of research exercises.
4. ***Case*** The 13th edition of this book includes the same mini-case that was introduced in the 12th edition: Forondo Artist Management Excellence Inc. (FAME). In the first three chapters, the case begins with a description provided in the "voice" of one or more stakeholders, revealing a new dimension of requirements to the reader. Each chapter has project assignments intended to provide guidance on the types of deliverables instructors could expect from students, some of which tie together issues and activities across chapters. These project assignments can be completed by individual students or by small project teams. This case provides an excellent means for students to gain hands-on experience with the concepts and tools they have studied. The instructor's manual will include new materials to support the use of the case.
5. ***Web Resources*** Each chapter contains a list of updated and validated URLs for Web sites that contain information that supplements the chapter. These Web sites cover online publication archives, vendors, electronic publications, industry standards organizations, and many other sources. These sites allow students and instructors to find updated product information, innovations that have appeared since the printing of the book, background information to explore topics in greater depth, and resources for writing research papers.

We continue to provide several pedagogical features that help make the 13th edition widely accessible to instructors and students. These features include the following:

1. ***Learning objectives*** appear at the beginning of each chapter, as a preview of the major concepts and skills students will learn from that chapter. The learning objectives—carefully updated to be aligned with the new chapter structure—also provide a great study review aid for students as they prepare for assignments and examinations.
2. ***Chapter introductions and summaries*** both encapsulate the main concepts of each chapter and link material to related chapters, providing students with a comprehensive conceptual framework for the course.
3. ***The chapter review*** includes the Review Questions, Problems and Exercises, and Field Exercises discussed earlier and also contains a Key Terms list to test the student's grasp of important concepts, basic facts, and significant issues.
4. ***A running glossary*** defines key terms in the page margins as they are discussed in the text. These terms are also defined at the end of the text, in the Glossary of Terms. Also included is the end-of-book Glossary of Acronyms for abbreviations commonly used in database management.

ORGANIZATION

We encourage instructors to customize their use of this book to meet the needs of both their curriculum and student career paths. The modular nature of the text, its broad coverage, its extensive illustrations, and its inclusion of advanced topics and emerging issues make customization easy. The many references to current publications and Web sites

can help instructors develop supplemental reading lists or expand classroom discussion beyond material presented in the text. The use of appendices for several advanced topics allows instructors to easily include or omit these topics.

The modular nature of the text allows the instructor to omit certain chapters or to cover chapters in a different sequence. For example, an instructor who wishes to emphasize data modeling may cover Chapter 14 (available on the book's Web site) on object-oriented data modeling along with or instead of Chapters 2 and 3. An instructor who wishes to cover only basic entity-relationship concepts (but not the enhanced E-R model) may skip Chapter 3 or cover it after Chapter 4 on the relational model.

We have contacted many adopters of *Modern Database Management* and asked them to share with us their syllabi. Most adopters cover the chapters in sequence, but several alternative sequences have also been successful. These alternatives include the following:

- Some instructors cover Chapter 12 on data and database administration immediately after Chapter 8 on physical database design and the relational model.
- To introduce SQL as early as possible, many instructors have effectively covered 12th edition Chapters 6 and 7 (SQL) immediately after Chapter 4; therefore, we have now placed them as Chapters 5 and 6. Some have even covered the new Chapter 5 immediately after Chapter 1, which the book makes possible.
- Many instructors have students read appendices along with chapters, such as reading Appendix on data modeling notations with Chapter 2 or Chapter 3 on E-R modeling, Appendix B on advanced normal forms with Chapter 4 on the relational model, and Appendix C on data structures with Chapter 8.

THE SUPPLEMENT PACKAGE: WWW.PEARSONHIGHERED.COM/HOFFER

A comprehensive and flexible technology support package is available to enhance the teaching and learning experience. All instructor and student supplements are available on the text Web site: **www.pearsonhighered.com/hoffer**.

For Students

The following online resources are available to students:

- *Complete chapters on distributed databases and object-oriented data modeling* as well as appendices focusing on data modeling notations, advanced normal forms, and data structures allow you to learn in depth about topics that are not covered in the textbook.
- *Accompanying databases* are also provided. Two versions of the Pine Valley Furniture Company case have been created and populated for the 13th edition. One version is scoped to match the textbook examples. A second version is fleshed out with more data and tables. This version is not complete, however, so that students can create missing tables and additional forms, reports, and modules. Databases are provided in several formats (ASCII tables, Oracle script, and Microsoft Access), but formats vary for the two versions. Some documentation of the databases is also provided. Both versions of the PVFC database are also provided on Teradata University Network.
- *Several custom-developed short videos that address key concepts and skills from different sections of the book* help students learn material that may be more difficult to understand by using both the printed text and a mini lecture.

For Instructors

The following online resources are available to instructors:

- The *Instructor's Resource Manual* by Heikki Topi, Bentley University, provides chapter-by-chapter instructor objectives, classroom ideas, and answers to Review Questions, Problems and Exercises, Field Exercises, and Project Case Questions.

The Instructor's Resource Manual is available for download on the instructor area of the text's Web site.

- The *Test Bank* and *TestGen*, by John Russo, Wentworth Institute of Technology, includes a comprehensive set of test questions in multiple-choice, true/false, and short-answer format, ranked according to level of difficulty and referenced with page numbers and topic headings from the text. The Test Bank is available in Microsoft Word and as the computerized TestGen. TestGen is a comprehensive suite of tools for testing and assessment. It allows instructors to easily create and distribute tests for their courses, either by printing and distributing through traditional methods or by online delivery via a local area network (LAN) server. Test Manager features Screen Wizards to assist you as you move through the program, and the software is backed with full technical support.
- *PowerPoint presentation slides*, by Michel Mitri, James Madison University, feature lecture notes that highlight key terms and concepts. Instructors can customize the presentation by adding their own slides or editing existing ones.
- The *Image Library* is a collection of the text art organized by chapter. It includes all figures, tables, and screenshots (as permission allows) and can be used to enhance class lectures and PowerPoint slides.
- *Accompanying databases* are also provided. Two versions of the Pine Valley Furniture Company case have been created and populated for the 13th edition. One version is scoped to match the textbook examples. A second version is fleshed out with more data and tables. This version is not complete, however, so that students can create missing tables and additional forms, reports, and modules. Databases are provided in several formats (ASCII tables, Oracle script, and Microsoft Access), but formats vary for the two versions. Some documentation of the databases is also provided. Both versions of the PVFC database are also available on Teradata University Network.

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V. Ramesh

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