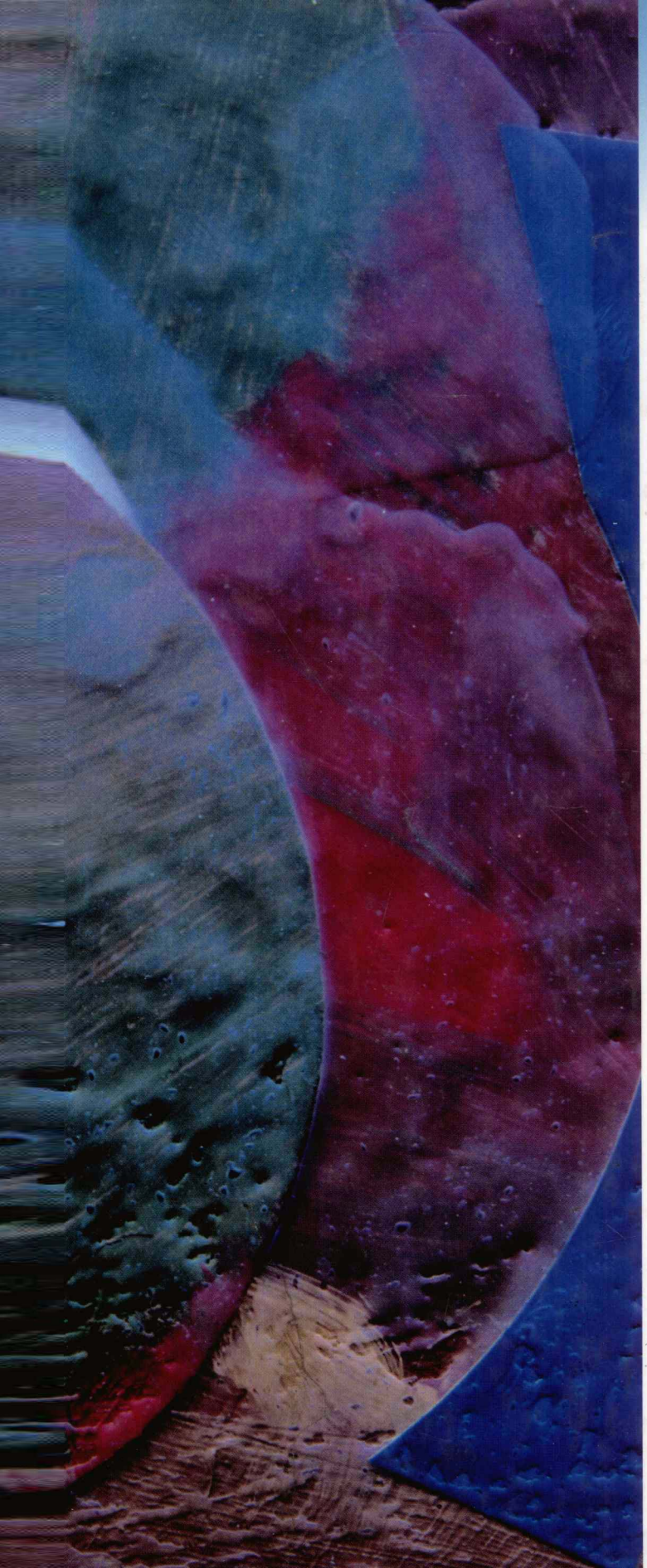

Modern Database Management

Fifth Edition

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Jeffrey A. Hoffer

Mary B. Prescott

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■ In memory of my valued colleague Daniel Couger. — *F. R. M.*

■ To Patty, for her sacrifices, encouragement, and support.
To my students, for being receptive and critical, and challenging me to be a better teacher. — *J. A. H.*

■ To Larry, Mike, and Ivan. Their love and support provide a foundation to my life which makes efforts such as writing this book possible. And to Jeff and Fred, who gave me the opportunity to write with them and patiently provided invaluable guidance along the way. — *M. B. P.*

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Preface

This text is designed for an introductory course 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 of Information Technology Professionals (AITP), Association for Computing Machinery (ACM), and International Federation of Information Processing Societies (IFIPS) curriculum guidelines (for example, IS '97) all outline this type of database management course. Previous editions of our text have been used successfully for more than a decade at both the undergraduate and graduate levels, as well as in management and professional development programs.

This text represents an extensive revision and updating of the fourth edition of *Modern Database Management*. These revisions are necessary to accommodate the technical, managerial, and methodological changes occurring at an ever-increasing pace in this field. However, we have endeavored to retain the best features of our previous editions. We have made every effort to justify the title *Modern Database Management*, which was introduced in the fourth edition.

In this fifth edition we welcome a third co-author, Mary Prescott of the University of South Florida. Mary has served both as a reviewer and user of the previous editions of our text in numerous database courses and professional development programs. She brings valuable new insights to the preparation of a new edition of this text.

NEW TO THIS EDITION

The fifth edition of *Modern Database Management* updates and expands materials in areas undergoing rapid change due to improved managerial practices, database design tools and methodologies, and database technology. This section presents a chapter-by-chapter description of the major changes in this edition. Each chapter description presents a one-sentence statement of the purpose of that chapter, followed by a description of the changes and revisions that have been made since the fourth edition. This paragraph concludes with a one-sentence description of the strengths that have been retained from the fourth edition.

Chapter 1: The Database Environment This chapter discusses the role of databases in organizations and previews the major topics in the remainder of the text. The chapter introduces a new classification scheme that recognizes four types of databases:

personal, work group, departmental, and enterprise. It also introduces a discussion of the evolution of database technologies from pre-database files to modern object-relational systems. The chapter continues to present a well-organized comparison of database technology compared to conventional file-processing systems.

Chapter 2: Database Development Process This chapter presents a detailed discussion of the role of database development within the broader context of information systems development. It is a synthesis of the material presented in Chapters 2 and 3 of the fourth edition. The chapter presents an expanded description of the systems development life cycle and the role of database development within that cycle. It also presents a new description of the prototyping methodology and its impact on database development. In addition, the chapter 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. The chapter continues to emphasize the information engineering methodology in database development, including the role of the enterprise data model.

Chapter 3: The Entity-Relationship Model This chapter presents a thorough introduction to conceptual data modeling with the entity-relationship model. The chapter contains an expanded discussion of several important topics, including weak entities, associative entities, and ternary relationships. The chapter continues to proceed from simple to more complex examples, and it concludes with a comprehensive E-R diagram for Pine Valley Furniture Company.

Chapter 4: The Enhanced E-R Model and Business Rules This is a new chapter for the fifth edition. It presents an expanded discussion of supertype/subtype relationships, which were covered in a single section in the fourth edition. It also provides an expanded discussion of business rules and their role, with an emphasis on the Ronald Ross graphical notation.

Chapter 5: Object-Oriented Modeling This chapter presents an introduction to object-oriented modeling using the Unified Modeling Language (UML) of Booch, Jacobson, and Rumbaugh. This chapter has been thoroughly updated. Using the UML provides an industry-standard notation for representing classes and objects. The chapter continues to emphasize basic O-O concepts such as inheritance and aggregation.

Chapter 6: Logical Database Design and the Relational Model This chapter describes the process of converting a conceptual data model to the relational data model. It features an improved logical organization compared to the fourth edition, with the process of transforming E-R diagrams into relations preceding the discussion of data normalization. There is also an expanded discussion of integrity constraints, including the representation of constraints using SQL code. The discussion of functional dependencies and normalization has been somewhat simplified. 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.

Chapter 7: Physical Database Design This chapter describes the steps that are essential in achieving an efficient database design. The chapter contains several important new topics, including controlling data integrity, designing physical records and denormalization, optimizing for query performance, bitmap indexes, and RAID. The chapter continues to emphasize the physical design process and the goals of that process.

Chapter 8: Client/Server and Middleware This is a predominantly new chapter in the fifth edition (the chapter does contain an updated version of some client/server topics that appeared at the beginning of Chapter 13 in the fourth edition). The purpose of the chapter is to provide a thoroughly modern discussion of the client/server architecture, applications, and middleware in contemporary database environments. Important new topics include the three-tier client/server architecture, application partitioning, role of the mainframe, and use of parallel computer architectures. Symmetric multiprocessing (SMP) and massively parallel processing (MPP) architectures are described and compared. The chapter concludes with a discussion of the role of middleware and connecting databases to the Internet.

Chapter 9: SQL This chapter presents a thorough introduction to the SQL language using the most recently released standard (SQL-92). New topics include integrity control statements, outer joins, an expanded discussion of correlated subqueries, maintenance of transaction integrity, and triggers and stored procedures. The chapter continues to use the Pine Valley Furniture Company case to illustrate a wide variety of practical queries and query results.

Chapter 10: Database Access from Client Applications The purpose of this chapter is to describe the use of visually oriented data manipulation languages. This chapter is a thorough update of Chapter 10 in the fourth edition. It describes accessing databases and building applications using Microsoft Access97 Query-by-Example. The chapter also describes the use of object-oriented features such as Object Linking and Embedding (OLE), Component Object Model, and ActiveX controls. It also describes embedding SQL in programs and the use of Visual Basic for Applications (VBA). As in the fourth edition, this chapter facilitates the comparison of visual languages with SQL through the use of common examples.

Chapter 11: Distributed Databases This chapter extensively updates and expands the material on distributed databases from Chapter 13 in the fourth edition. There is significant new coverage of the objectives and trade-offs for distributed databases, data replication alternatives, factors in selecting a data distribution strategy, and distributed database vendors and products. This chapter, along with Chapter 13 on data and database administration, provides thorough coverage of database concurrent access controls.

Chapter 12: Object-Oriented Database Development The purpose of this totally new chapter is to show how to translate object-oriented models (explained in Chapter 5) into class, object, relationship, and operation definitions for an object-oriented DBMS. The chapter also introduces object query language (OQL), the OO equivalent to SQL 5 and the standard query language for ODBMSs. The chapter concludes with a survey of ODBMSs—both vendors and products.

Chapter 13: Data and Database Administration 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 being performed. Updating and extending much of the material from Chapter 12 in the fourth edition, this chapter emphasizes the changing roles and approaches of data and database administration. It contains an expanded discussion of database backup procedures and data security threats and responses and provides a new description of managing data quality. There is also a new discussion of measures for tuning database performance. The chapter continues to emphasize the critical importance of data and database management in managing data as a corporate asset.

Chapter 14: Data Warehouse This chapter is completely new to the fifth edition. Its purpose is to describe the basic concepts of data warehousing and the reasons data warehousing is regarded as critical to competitive advantage in many organizations. Topics include alternative data warehouse architectures, techniques for data transformation and reconciliation, and the dimensional data model (or star schema) for data warehouses. User interfaces, including on-line analytical processing (OLAP) and data mining, are also described.

Appendices

The fifth edition contains four appendices intended for persons who wish to explore certain topics in greater depth.

Appendix A: Object-Relational Databases This appendix presents a description of object-relational database management systems (ORDBMS). This material is new to the fifth edition. Topics include features of an ORDBMS, enhanced SQL, advantages of the object-relational approach, and a summary of ORDBMS vendors and products.

Appendix B: Advanced Normal Forms This appendix presents a description (with examples) of Boyce/Codd and Fourth normal forms. This is an update of material that was presented in Chapter 6 of the fourth edition.

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.

Appendix D: Legacy DBMS This appendix, located on the Web site for this text (http://hepg.awl.com, keyword: McFadden), presents a brief summary of the hierarchical and network database models.

PEDAGOGY

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

1. **Problems and exercises** This section has been expanded in every chapter and contains a majority of new problems and exercises to support updated chapter material.
2. **Field exercises** This new section provides a set of "hands-on" minicases 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.
3. **Project case** The Mountain View Community Hospital case (which was used in the fourth edition as an expository case) has been totally restructured in the fifth edition as a student project. In each chapter the case begins with a brief description of the project as it relates to that chapter. The case then presents a series of project questions and exercises to 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.

We have also updated the pedagogical features that helped make the fourth edition widely accessible to instructors and students. These features include the following:

1. **Learning objectives** appear at the beginning of each chapter to preview the major concepts and skills students will learn from that chapter. The learning objectives 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**, which includes the problems, exercises, and field exercises discussed above, also contains **key terms** and **review questions** 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 text. These terms are also defined at the end of the text in the **glossary of terms**. Also included is an 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, extensive illustrations, and 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 allow 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 object-oriented database concepts may cover Chapter 5 and then skip to Chapter 12. Another instructor who wishes to cover only basic entity/relationship concepts (but not the enhanced E-R model or business rules) may skip Chapter 4.

CASE TOOLS ORACLE EDITION OF *MODERN DATABASE MANAGEMENT*

Modern Database Management, fifth edition is the first database book on the market to offer students an outstanding CASE tools software package from Oracle. For a few dollars more than the price of the text alone, students can purchase this book along with the full editions of **Oracle Designer/2000 2.1**, **Oracle Developer/2000 2.1**, and **Personal Oracle7, release 7.3.4**. We are proud to offer such a highly valued, powerful software package to students at such a low cost.

SUPPLEMENTS

- **Instructor's Manual/Test Bank** This volume provides chapter-by-chapter instructor objectives, classroom ideas, and answers to review questions, problems and exercises, field exercises, and project case questions. The Test Bank contains multiple-choice, true-false, and short-answer questions ranked according to level of difficulty and referenced with page numbers and topic headings from the text.
- **Instructor's Resource CD-ROM** This Windows-based CD contains PowerPoint presentation slides, the complete Instructor's Manual, and a computerized version of the Test Bank in Addison Wesley Longman's **TestGen-EQ test generating software**. TestGen-EQ enables instructors to view, edit, and add Test Bank questions and create highly customized tests in a variety of formats. The program's built-in question editor allows the user to create graphs, import graphics, and insert mathematical symbols and templates. The online testing component—**QuizMaster-EQ**—is fully networkable and automatically grades quizzes, stores results, and allows the instructor to view or print several types of grading reports.
- **Web Site** The Web site to accompany *Modern Database Management,* fifth edition includes Appendix D on Legacy DBMS, data sets for use with the Pine Valley Furniture case, and other useful resources and links for students and instructors. Please go to http://hepg.awl.com and use the keyword McFadden to check the site for the most current information and updates.

ACKNOWLEDGMENTS

We are grateful to numerous individuals who contributed to the preparation of *Modern Database Management,* fifth edition. First, we wish to thank our reviewers for their detailed suggestions and insights, characteristic of their thoughtful teaching style. Because of the extensive changes made from the fourth edition of *Modern Database Management,* analysis of topics and depth of coverage provided by the reviewers were crucial. Our reviewers include the following:

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We also thank Joe Valacich at Washington State University and Joey George at Louisiana State University for their great insights on the relationship of database development to the overall development of information systems. Their careful attention helps make our book compatible with books used in systems analysis and design courses, such as *Modern Systems Analysis and Design,* by Hoffer, George, and Valacich (Addison Wesley Longman).

We also thank Atish Sinha at the University of Dayton, who authored Chapters 5 and 12 on object-oriented database modeling and implementation. We sincerely appreciate all his efforts to integrate these chapters into the whole text by using the Pine Valley Furniture and Mountain View Community Hospital cases, to create parallel exercises which contrast OO approaches with entity-relationship and relational approaches, and to provide suggestions concerning all chapters. We also wish to acknowledge James Stanton, a student at University of Colorado–Colorado Springs, who prepared most of the PowerPoint graphics for Chapters 1, 3, 4, 6, and 14.

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We are most grateful to Oracle Corporation for making their powerful modeling and development tools—Designer/2000, Developer/2000, and Personal Oracle7—available for use with the fifth edition of *Modern Database Management.* We believe students will benefit greatly from having such easy access to these important CASE tools. We particularly wish to thank Rene Bonvanie and Randy Baker of Oracle Corporation, as well as Maureen Dorhety, Diane Shorts, Marie Schmitt, Susan Andolsek, and other Oracle employees who worked behind the scenes to make this partnership a reality.

Finally, we give immeasurable thanks to our families—spouses, children, and parents—who endured many evenings and weekends of solitude for the thrill of

seeing a book cover hang on a den wall. In particular, we marvel at the commitment of Evelyn McFadden and Patty Hoffer, who have lived the lonely life of a textbook author's spouse through five editions. We welcome Larry Prescott to this presainthood group. Much of the value of this text is due to their patience, encouragement, and love, but we alone bear the responsibility for any errors or omissions between the covers.

Fred R. McFadden
Jeffrey A. Hoffer
Mary B. Prescott

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