

SECOND EDITION

# DATABASE

DESIGN, APPLICATION DEVELOPMENT,  
& ADMINISTRATION

MICHAEL V. MANNINO



# DATABASE DESIGN, APPLICATION DEVELOPMENT, AND ADMINISTRATION

**SECOND EDITION**

**Michael V. Mannino**  
University of Colorado at Denver



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# ABOUT THE AUTHOR

**M**ichael V. Mannino has been involved in the database field since 1980. He has taught database management since 1983 at several major universities (University of Florida, University of Texas at Austin, University of Washington, and University of Colorado at Denver). His audiences have included undergraduate MIS students, graduate MIS students, MBA students, and doctoral students as well as corporate employees in retraining programs. He has also been active in database research as evidenced by publications in major journals of the IEEE (*Transactions on Knowledge and Data Engineering* and *Transactions on Software Engineering*), ACM (*Communications and Computing Surveys*), and INFORMS (*Inform Journal on Computing and Information Systems Research*). His research includes several popular survey and tutorial articles as well as many papers describing original research. Practical results of his research on a form-driven approach to database design are incorporated into Chapter 12.

***I wish to dedicate this book to my daughters, Julia and Aimee.  
Your smiles inspire me every day.***



# PREFACE

## MOTIVATING EXAMPLE

Paul Hong, the owner of International Industrial Glue, Inc., is anxious about the future of his business. Although his company has been very successful as an early adopter of Web technology, he is concerned about managing the growth of his business and continued utilization of Web technology. His business has grown rapidly as he embraced Web technology. Now he is unsure about which new directions to take to ensure the future growth of his business.

Paul Hong's main concern is updating the information technology infrastructure to support future expansion. He believes that the current infrastructure has reached its capacity to handle online order processing. Recent unavailability of the order entry website for one product line has resulted in a substantial lost sales opportunity. As his business has expanded into new markets, he has become concerned about the inability to track key business indicators across product lines. He is also concerned about management of nontraditional digital data such as product images and promotion videos as well as integrating XML product data with his order entry databases. For all of these concerns, he is unsure about proprietary versus nonproprietary technologies and standards.

All of these concerns involve significant usage of database technology as part of an enterprise computing infrastructure. Transaction processing features in enterprise DBMSs provide a foundation to increase online order processing performance as well as to improve website reliability. Data warehouse features in enterprise DBMSs provide the foundation to support small data marts as well as large data warehouses. Object database features provide the ability to manage nontraditional data as well as integrate XML product data with order entry data.

However, the solutions to Paul Hong's concerns are found not just in technology. Utilization of the appropriate level of technology involves a vision for an organization's future, a deep understanding of technology, and traditional management skills to manage risk. Paul Hong realizes that his largest challenge is to blend these skills so that effective solutions can be developed for International Industrial Glue, Inc.

## INTRODUCTION

This textbook provides a foundation to understand the database technology supporting enterprise computing concerns such as those faced by Paul Hong. As a new student of database management, you need to first understand the fundamental concepts of database management and the relational data model. Then you need to master

skills in database design and database application development. This textbook provides tools to help you understand relational databases and acquire skills to solve basic and advanced problems in query formulation, data modeling, normalization, application data requirements, and customization of database applications.

After establishing these skills, you are ready to study the role of database specialists and the processing environments in which databases are used. This textbook presents the fundamental database technologies in each processing environment and relates these technologies to new advances in electronic commerce and enterprise computing. You will learn the vocabulary, architectures, and design issues that provide a background for advanced study of individual database management systems, electronic commerce applications, and enterprise computing.

## WHAT'S NEW IN THE SECOND EDITION

The second edition goes beyond mere refinements to the first edition. The second edition provides a considerable amount of new material and presents material from the first edition in a significantly new manner. The relentless expansion of database technology motivates most of the new material. Database technology continues to evolve rapidly in areas such as data warehouses, object-oriented databases, transaction management, and storage/optimization technologies. The second edition reflects these trends with new material about SQL:1999 and Oracle 9i, relational database technologies for data warehouses, data warehouse population processes, object-relational features in Oracle 9i, and optimization features including bitmap indexes and star joins.

The other motivation for making changes to this second edition is classroom experience with the first edition. Experience gained from my own instruction of undergraduate and graduate students along with feedback from adopters of the first edition have led to the development of new material and refinements to existing material. The most significant refinement involves data modeling coverage. Frustration with student difficulties in data modeling motivated the separation of data modeling coverage between mastering the notation (Chapter 5) and applying the notation to business problems (Chapter 6). The most significant new material is in Chapter 11 on stored procedures and triggers. This chapter was motivated by my instruction of triggers and stored procedures in an advanced database course. Additional new and refined material motivated by classroom usage of the first edition include revised coverage of normalization, the management of stored procedures and triggers, nested queries in the FROM clause, database benchmarks, refinements to transaction processing coverage, and updated coverage of SQL:1999.

In addition to new material and refinements to existing material, the second edition extends the chapter supplements. The second edition contains many new end-of-chapter questions and problems as well as SQL:1999 syntax summaries. In addition, the ER Assistant, the bundled data modeling tool, has been significantly revised, especially to support the diagram rules presented in Chapter 5.

The second edition also has a revised chapter organization to reflect the progression of topics in database design, application development, and database administration. Part 1 covers just foundation knowledge instead of details about application development. Part 2 still covers database design except for the chapters about view integration and the case study. Part 3 covers database application development, including the new chapter on stored procedures and triggers. The coverage of view integration and the case study has been moved to Part 3 to integrate database design with application development. Part 4 covers database administration and processing environments for DBMSs, material that was presented in Part 3 of the first edition.

## COMPETITIVE ADVANTAGES

This textbook provides outstanding features unmatched in competing textbooks. The unique features include detailed SQL coverage for both Access and Oracle, problem-solving guidelines to aid acquisition of key skills, carefully designed sample databases and examples, a comprehensive case study, advanced topic coverage, integrated lab material, and the bundled ER Assistant. These features provide a complete package for an introductory database course. Each of these features is described in more detail in the list below whereas Table P.1 summarizes the competitive advantages by chapter.

- **SQL Coverage:** The breadth and depth of the SQL coverage in this text is unmatched by competing textbooks. Table P.2 summarizes SQL coverage by chapter. Parts 1 and 3 provide a thorough coverage of the CREATE TABLE, SELECT, UPDATE, INSERT, DELETE, CREATE VIEW, and CREATE TRIGGER statements. Numerous examples of basic, intermediate, and advanced problems are presented. The chapters in Part 4 cover statements useful for database administrators as well as statements used in specific processing environments.
- **Access and Oracle Coverage:** The chapters in Parts 1 and 3 provide detailed coverage of both Access and Oracle SQL. Each example for the SELECT, INSERT, UPDATE, DELETE, and CREATE VIEW statements are shown for both database management systems. Significant coverage of new Oracle 9i

**TABLE P.1** Summary of Competitive Advantages by Chapter

Chapter	Unique Features
2	Visual representation of relational algebra operators
3	Query formulation guidelines; Oracle, Access, and SQL:1999 SQL coverage
4	Unique chapter providing a conceptual introduction to the database development process
5	Emphasis on ERD notation; diagram rules with support in the ER Assistant
6	Emphasis on the practice of data modeling; data modeling guidelines and transformations
7	Normalization guidelines and procedures
8	Index selection rules; SQL tuning guidelines; integrated coverage of query optimization, file structures, and index selection
9	Query formulation guidelines; Oracle (8i and 9i), Access, and SQL:1999 SQL coverage; advanced topic coverage of nested queries, division problems, and null value handling
10	Updatable view rules; data requirement guidelines for forms and reports
11	Unique chapter covering concepts and practices of database programming languages, stored procedures, and triggers
12	Unique chapter covering concepts and practices of view integration and design
13	Unique chapter providing a comprehensive case study on student loan processing
14	Guidelines for important processes used by database administrators
15	Transaction design guidelines and advanced topic coverage
16	Advanced topic coverage of relational database features for data warehouse processing and the data warehouse refresh process: extensive Oracle 9i data warehouse coverage
17	Integrated coverage of distributed processing and distributed databases
18	Advanced topic coverage of object-relational features in SQL:1999 and Oracle 9i



**TABLE P.2 SQL Statement Coverage by Chapter**

Chapter	SQL Statements
2	CREATE TABLE
3	SELECT, INSERT, UPDATE, DELETE
9	SELECT (nested queries, outer joins, null value handling); Access, Oracle (8i and 9i), and SQL:1999 coverage
10	CREATE VIEW; queries and manipulation statements using views
11	CREATE PROCEDURE (Oracle), CREATE TRIGGER (Oracle)
14	GRANT, REVOKE, CREATE ROLE, CREATE ASSERTION, CHECK clause of the CREATE TABLE statement, CREATE DOMAIN
15	BEGIN TRANSACTION, COMMIT, SET TRANSACTION, SET CONSTRAINTS, SAVEPOINT
16	CREATE MATERIALIZED VIEW (Oracle), GROUP BY clause extensions, CREATE DIMENSION (Oracle)
18	CREATE TYPE, CREATE TABLE (typed tables), SELECT (object identifiers, path expressions, dereference operator); SQL:1999 and Oracle 9i coverage

SQL features appears in Chapters 9, 11, 16, and 18. In addition, the chapters in Parts 1 and 3 cover SQL:1999 syntax to support instruction with other prominent database management systems.

- **Problem-Solving Guidelines:** Students need more than explanations of concepts and examples to solve problems. Students need guidelines to help structure their thinking process to tackle problems in a systematic manner. The guidelines provide mental models to help students apply the concepts to solve basic and advanced problems. Table P.3 summarizes the unique problem-solving guidelines by chapter.
- **Sample Databases and Examples:** Two sample databases are used throughout the chapters of Parts 1 and 3 to provide consistency and continuity. The University database is used in the chapter examples, while the Order

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FacSSN	SurfName	FacLastname	FacSalary	StuSSN	StuFirstName	StuLastname	StuSSN
				12345678	JOHN	WELLS	1
				12345679	JOHN	WELLS	2
				12345680	JOHN	WELLS	3
				12345681	CANDY	MENDALL	4
				12345682	CANDY	MENDALL	5
				12345683	CANDY	MENDALL	6
				12345684	JOHN	WELLS	7
				12345685	JOHN	WELLS	8
				12345686	JOHN	WELLS	9
				12345687	JOHN	WELLS	10
				12345688	JOHN	WELLS	11
				12345689	JOHN	WELLS	12
				12345690	JOHN	WELLS	13
				12345691	JOHN	WELLS	14
				12345692	JOHN	WELLS	15
				12345693	JOHN	WELLS	16
				12345694	JOHN	WELLS	17
				12345695	JOHN	WELLS	18
				12345696	JOHN	WELLS	19
				12345697	JOHN	WELLS	20
				12345698	JOHN	WELLS	21
				12345699	JOHN	WELLS	22
				12345700	JOHN	WELLS	23
				12345701	JOHN	WELLS	24
				12345702	JOHN	WELLS	25
				12345703	JOHN	WELLS	26
				12345704	JOHN	WELLS	27
				12345705	JOHN	WELLS	28
				12345706	JOHN	WELLS	29
				12345707	JOHN	WELLS	30
				12345708	JOHN	WELLS	31
				12345709	JOHN	WELLS	32
				12345710	JOHN	WELLS	33
				12345711	JOHN	WELLS	34
				12345712	JOHN	WELLS	35
				12345713	JOHN	WELLS	36
				12345714	JOHN	WELLS	37
				12345715	JOHN	WELLS	38
				12345716	JOHN	WELLS	39
				12345717	JOHN	WELLS	40
				12345718	JOHN	WELLS	41
				12345719	JOHN	WELLS	42
				12345720	JOHN	WELLS	43
				12345721	JOHN	WELLS	44
				12345722	JOHN	WELLS	45
				12345723	JOHN	WELLS	46
				12345724	JOHN	WELLS	47
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				12345741	JOHN	WELLS	64
				12345742	JOHN	WELLS	65
				12345743	JOHN	WELLS	66
				12345744	JOHN	WELLS	67
				12345745	JOHN	WELLS	68
				12345746	JOHN	WELLS	69
				12345747	JOHN	WELLS	70
				12345748	JOHN	WELLS	71
				12345749	JOHN	WELLS	72
				12345750	JOHN	WELLS	73
				12345751	JOHN	WELLS	74
				12345752	JOHN	WELLS	75
				12345753	JOHN	WELLS	76
				12345754	JOHN	WELLS	77
				12345755	JOHN	WELLS	78
				12345756	JOHN	WELLS	79
				12345757	JOHN	WELLS	80
				12345758	JOHN	WELLS	81
				12345759	JOHN	WELLS	82
				12345760	JOHN	WELLS	83
				12345761	JOHN	WELLS	84
				12345762	JOHN	WELLS	85
				12345763	JOHN	WELLS	86
				12345764	JOHN	WELLS	87
				12345765	JOHN	WELLS	88
				12345766	JOHN	WELLS	89
				12345767	JOHN	WELLS	90
				12345768	JOHN	WELLS	91
				12345769	JOHN	WELLS	92
				12345770	JOHN	WELLS	93
				12345771	JOHN	WELLS	94
				12345772	JOHN	WELLS	95
				12345773	JOHN	WELLS	96
				12345774	JOHN	WELLS	97
				12345775	JOHN	WELLS	98
				12345776	JOHN	WELLS	99
				12345777	JOHN	WELLS	100

Some DBMSs (such as Microsoft Access 2002 and Oracle 8i) do not directly support the full outer join operation. In these systems, a full outer join can be simulated by taking the union of two one-sided outer joins using the steps shown below. The SELECT statement implementing these steps is shown in Example 9.5.

1. Construct a right join of Faculty and Student (unmatched rows of Student).
2. Construct a left join of Faculty and Student (unmatched rows of Faculty).
3. Construct a union of these two temporary tables. Remember when using the UNION operator, the two table arguments must be column compatible: each corresponding column from both tables must have compatible data types. Otherwise, the UNION operator will not work as expected.

**Example 9.5 (JCLSS)** Full Outer Join Using a Union of Two One-Sided Outer Joins

Combine the Faculty and Student tables using a full outer join. List the social security number, the name (first and last), the salary (faculty only), and the GPA (students only) as the result. The result is identical to Example 9.4.

```

SELECT FacSSN, FacFirstName, FacLastName, FacSalary,
       StuSSN, StuFirstName, StuLastName, StuGPA
FROM Faculty RIGHT JOIN Student
ON Student.StuSSN = Faculty.FacSSN
UNION
SELECT FacSSN, FacFirstName, FacLastName, FacSalary,
       StuSSN, StuFirstName, StuLastName, StuGPA
FROM Faculty LEFT JOIN Student
ON Student.StuSSN = Faculty.FacSSN

```

**Example 9.5 (JCLSS)** Full Outer Join Using a Union of Two One-Sided Outer Joins

Combine the Faculty and Student tables using a full outer join. List the social security number, the name (first and last), the salary (faculty only), and the GPA (students only) as the result. The result is identical to Example 9.4.

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SELECT FacSSN, FacFirstName, FacLastName, FacSalary,
       StuSSN, StuFirstName, StuLastName, StuGPA
FROM Faculty RIGHT JOIN Student
ON Student.StuSSN = Faculty.FacSSN
UNION
SELECT FacSSN, FacFirstName, FacLastName, FacSalary,
       StuSSN, StuFirstName, StuLastName, StuGPA
FROM Faculty LEFT JOIN Student
ON Student.StuSSN = Faculty.FacSSN

```

**TABLE P.3**      **Problem-Solving Guidelines by Chapter**

<i>Chapter</i>	<i>Problem-Solving Guidelines</i>
2	Visual representation of relationships and relational algebra operators
3	Conceptual evaluation process; query formulation questions
5	Diagram rules
6	Design transformations; common design errors; conversion rules
7	Combined definition of 2NF/3NF; simple synthesis procedure
8	Index selection rules; SQL tuning guidelines
9	Nested query evaluation; count method for division problems
10	Rules for updatable join queries; steps for analyzing data requirements in forms and reports
11	Trigger execution procedure
12	Form analysis steps; view integration strategies
14	Guidelines to manage stored procedures and triggers; data planning process; DBMS selection process
15	Transaction timeline; transaction design guidelines
16	Guidelines for relational database representations of multidimensional data; guidelines for refreshing a data warehouse
17	Progression of transparency levels for distributed databases
18	Object database architectures; comparison between relational and object-relational representations

Entry database is used in the end-of-chapter problems. Numerous examples and problems with these databases depict the fundamental skills of query formulation and application data requirements. Revised versions of the databases provide separation between basic and advanced examples. The website contains CREATE TABLE statements, sample data, data manipulation statements, and Access database files for both databases. Icons for the University and Order Entry databases are placed in the margins of the text to call out to students when an example begins.

Chapters in Parts 2 and 4 use additional databases to broaden exposure to more diverse business situations. Students need exposure to a variety of business situations to acquire database design skills and understand concepts important to database specialists. Other databases covering water utility operations, patient visits, academic paper reviews, personal financial tracking, airline reservations, placement office operations, automobile insurance, store sales tracking, and real estate sales supplement the University and Order Entry databases in the chapter examples and end-of-chapter problems.

- **Comprehensive Case Study:** The Student Loan, Unlimited Case is found at the end of Part 3. The case description along with its solution integrates the concepts students learned in the preceding 12 chapters on application development and database design. The follow-up problems at the end of the chapter provide additional opportunities for students to apply their knowledge on a realistic case.
- **Optional Integrated Labs:** Database management is best taught when concepts are closely linked to the practice of designing and implementing databases using a commercial DBMS. To help students apply the concepts described in the textbook, optional supplementary lab materials are available

on CD-ROM and the text's website. The CD-ROM contains labs for three Microsoft Access versions (97, 2000, and 2002) as well as practice databases and practice exercises. The Microsoft Access labs integrate a detailed coverage of Access with the application development concepts covered in Parts 1 and 3.

- **Free Data Modeling Tool:** The ER Assistant provides a simple interface for drawing and analyzing entity relationship diagrams as presented in the Part 2 chapters on database development. This unique, DBMS-independent program is packaged free with each student copy of the text. Students can quickly become productive with this program, enabling them to focus on the concepts of data modeling rather than the details of a complex CASE tool. To help students avoid diagram errors, the ER Assistant supports the diagram rules presented in Chapter 5.
- **Current and Cutting-Edge Topics:** This book covers some topics that are missing from competing textbooks: advanced query formulation, updatable views, development and management of stored procedures and triggers, data requirements for data entry forms and reports, view integration, population process for data warehouses, Web database connectivity architectures, object database architectures, data warehouse features in SQL:1999 and Oracle 9i, object-relational features in SQL:1999 and Oracle 9i, and transaction design principles. These topics can help motivated students obtain a deeper understanding of database management.
- **Complete Package for Course:** Depending on the course criteria, some students may need to purchase as many as five books for an introductory database course: a textbook covering principles, laboratory books covering details of a DBMS and a CASE tool, a supplemental SQL book, and a casebook with realistic practice problems. This textbook and supplemental material provide one complete and less expensive source for the student. In addition to the expense of using many separate books and lab manuals, the separate books lack an integrated approach.

## TEXT AUDIENCE

This book is intended for a first undergraduate or graduate course in database management. At the undergraduate level, students should have a concentration (major or minor) or active interest in information systems. For two-year institutions, the instructor may want to skip the advanced topics and place more emphasis on the optional Access lab book. Undergraduate students should have a first course covering general information systems concepts, spreadsheets, word processing, and possibly a brief introduction to databases. Except for Chapter 11, a previous course in computer programming can be useful background but is not mandatory. The chapters reference computer programming concepts, but writing code is not covered. For a complete understanding of Chapter 11, computer programming background is essential. However, the basic concepts in Chapter 11 can be covered even if students do not have computer programming background.

At the graduate level, this book is suitable in either MBA or Master of Science (in information systems) programs. The advanced material in this book should be especially suitable for Master of Science students.

## ORGANIZATION

As the title suggests, *Database Design, Application Development, and Administration* emphasizes three sets of skills. Before acquiring these skills, students need a

foundation about basic concepts. Part 1 provides background for subsequent detailed study of database design, database application development, and database administration. The chapters in Part 1 present the principles of database management, the relational data model, and query formulation.

Part 2 provides a foundation for database design. Students desiring a career as a database administrator should be able to perform each step of the database development process. Students should learn skills of data modeling, schema conversion, normalization, and physical database design.

The chapters in Part 2 emphasize practical skills and design processes for the database development process. Chapter 4 introduces the context, objectives, phases, and tools of the database development process. Chapters 5 and 6 cover data modeling using the Entity Relationship Model. Chapter 7 covers the motivation, functional dependencies, normal forms, and practical considerations of data normalization. Chapter 8 contains broad coverage of physical database design including the objectives, inputs, file structure and query optimization background, and important design choices.

Part 3 provides a foundation for building database applications by helping students acquire skills in advanced query formulation, specification of data requirements for data entry forms and reports, coding triggers and stored procedures, and using views in the design of complex databases. Chapter 9 presents additional examples of intermediate and advanced SQL, along with corresponding query formulation skills. Chapter 10 describes the motivation, definition, and usage of relational views along with specification of view definitions for data entry forms and reports. Chapter 11 presents concepts and coding practices of database programming languages, stored procedures, and triggers for customization of database applications. Chapter 12 describes view design and view integration, which are data modeling concepts for large database development efforts. Chapter 13 provides a comprehensive case study that enables students to gain insights about the difficulties of applying database design and application development skills to a realistic business database.

Beyond the database design and application development skills, this textbook prepares students for careers as database specialists. Students need to understand the responsibilities, tools, and processes employed by data administrators and database administrators as well as the various environments in which databases operate.

The chapters in Part 4 emphasize the role of database specialists and the details of managing databases in various operating environments. Chapter 14 provides a context for the other chapters through coverage of the responsibilities, tools, and processes used by database administrators and data administrators. The other chapters in Part 4 provide a foundation for managing databases in important environments: Chapter 15 on transaction processing, Chapter 16 on data warehouses, Chapter 17 on distributed processing and data, and Chapter 18 on object database management. These chapters emphasize concepts, architectures, and design choices important for database specialists.

## TEXT APPROACH AND THEME

To support acquisition of the necessary skills for learning and understanding application development, database design, and managing databases, this book adheres to three guiding principles:

1. *Combine concepts and practice.* Database management is more easily learned when concepts are closely linked to the practice of designing and implementing databases using a commercial DBMS. The textbook and the

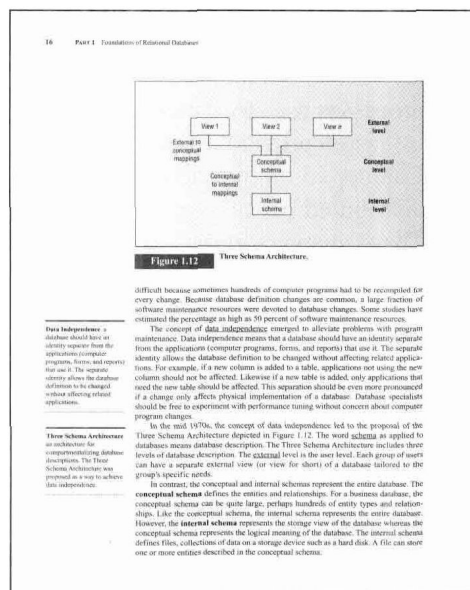
accompanying supplements have been designed to provide close integration between concepts and practice through the following features:

- SQL examples for both Access and Oracle as well as SQL:1999 coverage.
  - Emphasis of the relationship between application development and query formulation.
  - Usage of a data modeling notation supported by professional CASE tools and an easy-to-use academic tool (ER Assistant).
  - Supplemental laboratory practice chapters that combine textbook concepts with details of commercial DBMSs.
2. *Emphasize problem-solving skills.* This book features problem-solving guidelines to help students master the fundamental skills of data modeling, normalization, query formulation, and application development. The textbook and associated supplements provide a wealth of questions, problems, case studies, and laboratory practices in which students can apply their skills. With mastery of the fundamental skills, students will be poised for future learning about databases and change the way they think about computing, in general.
  3. *Provide introductory and advanced material.* Business students who use this book may have a variety of backgrounds. This book provides enough depth to satisfy the most eager students. However, the advanced parts are placed so that they can be skipped by the less inclined.

## PEDAGOGICAL FEATURES

This book contains the following pedagogical features to help students work their way through chapter content in a sensible and organized fashion:

- **Learning Objectives** focus on the knowledge and skills students will acquire from studying the chapter.
- **Overviews** provide a snapshot or preview of chapter contents.
- **Key Terms** are highlighted and defined in the margins as they appear in the chapter.



- **Examples** are clearly separated from the rest of the chapter material for easier review and studying purposes.

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It is possible to have multiple levels of nested queries if desired. In a nested query, you can have another nested query using the IN comparison operator in the WHERE clause. In Example 9.10, the nested query on the Offering table has a nested query on the Faculty table. No Faculty columns are needed in the main query or in the nested query on Offering.

**Example 9.10** Using a Type 1 Nested Query Inside Another Type 1 Nested Query

Retrieve the name, the city, and the grade of students who have a high grade (≥ 3.5) in a course offered in fall 2002 taught by Leonard Vince.

```

SELECT StuFirstName, StuLastName, StuCity, EnrGrade
FROM Student, Enrollment
WHERE Student.StuSSN = Enrollment.StuSSN
AND EnrGrade ≥ 3.5 AND Enrollment.OfferNo IN
( SELECT OfferNo FROM Offering
  WHERE OfferNo = 'FALL' AND OfferYear = 2002
  AND FacSSN IN
    ( SELECT FacSSN FROM Faculty
      WHERE FacFirstName = 'LEONARD'
      AND FacLastName = 'VINCE' ) )

```

StuFirstName	StuLastName	StuCity	EnrGrade
CARNEY	KENDALL	TACOMA	3.5
MARIAH	DOOGIE	SEATTLE	3.8
HOMER	WELLS	SEATTLE	3.5
ROBERTO	MORALES	SEATTLE	3.5

The Type 1 style gives a visual feel to a query. You can visualize a Type 1 subquery as navigating between tables. Visit the table in the subquery to collect join values that can be used to select rows from the table in the outer query. The use of Type 1 nested queries is largely a matter of preference. Even if you do not prefer this join style, you should be prepared to interpret queries written by others with Type 1 nested queries.

The DELETE statement provides another use of a Type 1 nested query. A Type 1 nested query is useful when the deleted rows are related to other rows, as demonstrated in Example 9.11. Using a Type 1 nested query is the standard way to reference related tables in DELETE statements. Chapter 3 demonstrated the join operator style inside a DELETE statement, a proprietary extension of Microsoft Access. For your reference, Example 9.12 shows a DELETE statement using the join operator style that removes the same rows as Example 9.11.

**Example 9.11** DELETE Statement Using a Type 1 Nested Query

Delete offerings taught by Leonard Vince. Three Offering rows are deleted. In addition, this statement deletes related rows in the Enrollment table because the ON DELETE clause is set to CASCADE.

```

DELETE FROM Offering
WHERE Offering.FacSSN IN
( SELECT FacSSN FROM Faculty
  WHERE FacFirstName = 'LEONARD'
  AND FacLastName = 'VINCE' )

```

- **Running Database Examples**—University and Order Entry with icons in margins to draw student attention to examples.
- **Closing Thoughts** summarize what students have learned in the chapter.
- **Review Concepts** are the important conceptual highlights from the chapter, not just a list of terminology.
- **Questions** are provided to review the chapter concepts.
- **Problems** are included to help students practice and implement what they have learned.
- **References for Further Study** point students to additional sources on chapter content.
- **Chapter Appendixes** provide more in-depth treatment of certain principles or practices.

At the end of the text, students will find the following additional resources:

- **Glossary:** Provides a complete list of terms and definitions used throughout the text.
- **Bibliography:** A list of helpful industry, academic, and other printed material for further research or study.

In addition, a list of Web resources can be found in the Online Learning Center, [www.mhhe.com/mannino](http://www.mhhe.com/mannino).

## ACCESS LAB ON CD-ROM

Lab books for both Microsoft Access 97, 2000, and 2002 are available on CD-ROM as packaging options with this text. The lab books provide detailed coverage of features important to beginning database students

as well as many advanced features. The lab chapters provide a mixture of guided practice and reference material organized into the following chapters:

1. An Introduction to Microsoft Access
2. Database Creation Lab
3. Query Lab
4. Single Table Form Lab
5. Hierarchical Form Lab
6. Report Lab
7. Pivot Tables and Data Access Pages (Access 2002 only)
8. User Interface Lab

Each lab chapter follows the pedagogy of the textbook with Learning Objectives, Overview, Closing Thoughts, Additional Practice exercises, and Appendixes of helpful tips. Most lab chapters reference concepts from the textbook for close integration with corresponding textbook chapters. Each lab book also includes a glossary of terms and an index.

## INSTRUCTOR RESOURCES

A comprehensive set of supplements for the text and lab manuals is available to adopters. These include:

- Instructor CD-ROM to contain Instructor's Manual, PowerPoint slides, Test Bank, and Computerized Test Bank. The test data bank provides problems for assignments, midterm exams, and final exams, in addition to questions to test basic understanding.
- Website/Online Learning Center, [www.mhhe.com/mannino](http://www.mhhe.com/mannino). The instructor center contains problem solutions, an exam and assignment data bank, PowerPoint lecture notes, case study solutions, and laboratory assignment solutions.

## TEACHING PATHS

The textbook can be covered in several orders in a one- or a two-semester sequence.

The author has taught a one-semester course with the ordering of application development, database development, and database processing environments. This ordering has the advantage of covering the more concrete material (application development) before the more abstract material (database development). Lab chapters and assignments are used for practice beyond the textbook chapters. To fit into one semester, advanced topics in Chapters 8, 9, 11, 12, 15, 16, 17, and 18 may be skipped.

A second ordering is to cover database development before application development. For this ordering, the author recommends following the textbook ordering. This ordering supports a more thorough coverage of database development while not neglecting application development. To fit into one semester, advanced topics in Chapters 8, 9, 11, 12, 15, 16, 17, and 18 may be skipped.

A third possible ordering is to use the textbook in a two-course sequence. The first course covers database management fundamentals from Part 1, data modeling and normalization from Part 2, and advanced query formulation, application development with views, and view integration from Part 3. Because of the second course, the material on database design can be covered in more depth than one course alone permits. The second course emphasizes database administration skills with physical database design from Part 2, triggers and stored procedures from Part 3, and the processing environments

from Part 4 along with additional material on managing enterprise databases. A comprehensive project can be used in the second course to integrate application development, database development, and database administration.

## STUDENT RESOURCES

- **ER Assistant:** Packaged free with each student text, this easy-to-use data modeling tool can be used to draw and analyze ERDs.
- **Integrated Access Labs:** Available as a packaging option, these Access 97, 2000, and 2002 labs are available on CD-ROM and include additional sample databases and practice exercises not found in the text.
- **Website/Online Learning Center, [www.mhhe.com/mannino](http://www.mhhe.com/mannino):** The student center contains study outlines that include learning objectives, chapter overviews, summaries and key terms from the text, self-assessment quizzes, and other helpful online resources.

## ACKNOWLEDGMENTS

The second edition of this textbook is the culmination of many years of work. Before beginning the first edition, I wrote tutorials, laboratory practices, and case studies. This material was first used to supplement other textbooks. After encouragement from students, this material was used without a textbook. This material, revised many times through student comments, was the foundation for the first edition. During the development of the first edition, the material was classroom tested for three years with hundreds of undergraduate and graduate students, along with careful review through four drafts by many outside reviewers. The second edition was developed through classroom usage of the first edition for three years, along with teaching an advanced database course for several years.

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**Michael V. Mannino**