

PHIL PRATT

MARY LAST

A GUIDE TO

SQL

The background of the cover is a dark, deep blue. It is filled with a complex network of glowing, multi-colored lines in shades of purple, blue, and green. These lines appear to be light trails or data paths, some straight and some curved, creating a sense of dynamic movement. Scattered throughout the scene are numerous small, bright particles or 'stars' in various colors, including white, blue, and purple. At the bottom center, there is a bright, glowing horizontal band of light, from which the lines and particles seem to emanate or converge.

Ninth Edition

A GUIDE TO SQL

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A Guide to SQL, Ninth Edition
Philip J. Pratt and Mary Z. Last

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PREFACE

Structured Query Language (or SQL, which is pronounced “se-quel,” or “ess-cue-ell”) is a popular computer language that is used by diverse groups such as home computer users, owners of small businesses, end users in large organizations, and programmers. Although this text uses the SQL implementation in the Oracle Database 11g Express Edition as a vehicle for teaching SQL, its chapter material, examples, and exercises can be completed using any SQL implementation.

A Guide to SQL, Ninth Edition is written for a wide range of teaching levels, from students taking introductory computer science classes to those students in advanced information systems classes. This text can be used for a standalone course on SQL or in conjunction with a database concepts text where students are required to learn SQL.

The chapters in this text should be covered in order. Students should complete the end-of-chapter exercises and the examples within the chapters for maximum learning. Because the content of Chapter 8 assumes that the reader has had instruction or experience in at least one programming language, the instructor should determine whether students will understand its concepts. Students without a programming background will have difficulty understanding the topic of embedded SQL. Instructors can easily omit Chapter 8 from the text in situations where students are not comfortable with programming examples.

The Ninth Edition builds on the success of previous editions by presenting basic SQL commands in the context of a business that uses SQL to manage orders, items, customers, and sales reps. Like in previous editions, this edition uses Oracle as the vehicle to present SQL commands. Like the last edition, this edition addresses SQL in Access™ by showing the Access versions of the same commands when they differ from the Oracle versions. This edition also shows SQL Server commands when they differ from the Oracle versions. Differences for Access and SQL Server users are featured in “User” notes, which make it easy for students to identify differences for the SQL implementation they are using. Students can download the Oracle 11g Database Express Edition from the Oracle Web site for free and use it to complete this text without having to purchase or install the full Oracle program.

The Ninth Edition includes an entire chapter on database design, showing students how to create an appropriate design that satisfies a given set of requirements, and includes coverage of the important topics of stored procedures and triggers. The text also contains updated case problems that feature a distributor of toys, an outdoor adventure company, and a condominium management company.

DISTINGUISHING FEATURES

Use of Examples

Each chapter contains multiple examples that use SQL to solve a problem. Following each example, students will read about the commands that are used to solve the stated problem, and then they will see the SQL commands used to arrive at the solution. For most students, learning through examples is the most effective way to master material. For this reason, instructors should encourage students to read the chapters at the computer and input the commands shown in the figures.

Case Studies

A running case study—TAL Distributors—is presented in all of the examples within the chapters and in the first set of exercises at the end of each chapter. Although the database is small in order to be manageable, the examples and exercises for the TAL Distributors database simulate what a real business can accomplish using SQL commands. Using the same case study as examples within the chapter and in the end-of-chapter exercises ensures a high level of continuity to reinforce learning.

A second case study—the Colonial Adventure Tours database—is used in a second set of exercises at the end of each chapter. A third case study—the Solmaris Condominium Group database—is used in a third set of exercises at the end of each chapter. The second and third case studies give students a chance to venture out “on their own” without the direct guidance of examples from the text.

Question and Answer Sections

A special type of exercise, called a Q&A, is used throughout the book. These exercises force students to consider special issues and understand important questions before continuing with their study. The answer to each Q&A appears after the question. Students are encouraged to formulate their own answers before reading the ones provided in the text to ensure that they understand new material before proceeding.

“User” Notes for Access™ and SQL Server Users

When an SQL command has a different use or format in Access or SQL Server, it appears in a User note. When you encounter a User note for the SQL implementation you are using, be sure to read its contents. You might also review the User notes for other SQL implementations so you are aware of the differences that occur from one implementation of SQL to another.

Review Material

A Summary and Key Terms list appear at the end of each chapter, followed by Review Questions that test students’ recall of the important points in the chapter and occasionally test their ability to apply what they have learned. The answers to the

odd-numbered Review Questions are provided in Appendix C. Each chapter also contains exercises related to the TAL Distributors, Colonial Adventure Tours, and Solmaris Condominium Group databases. Critical-thinking questions that reinforce problem-solving and analytical skills are included for review questions and hands-on exercises.

Appendices

Three appendices appear at the end of this text. Appendix A is an SQL reference that describes the purpose and syntax for the major SQL commands featured in the text. Students can use Appendix A to identify how and when to use important commands quickly. The SQL reference appendix contains references to specific pages in the text where the command is discussed to make it easy for students to find additional information when they need to refer back to the section in the book where the topic is covered.

Appendix B includes a “How Do I” reference, which lets students cross-reference the appropriate section in Appendix A by searching for the answer to a question. Appendix C includes answers to the odd-numbered Review Questions.

Relationship to Concepts of Database Management, Eighth Edition

For database courses featuring SQL, this SQL text can be bundled with *Concepts of Database Management, Eighth Edition* by Pratt and Last (Cengage Learning). The data and pedagogy between the two texts is consistent, and the instructor’s manuals for both books include feedback and suggestions for using the texts together.

Instructor Support

The Ninth Edition includes a package of proven supplements for instructors and students. The Instructor’s Resources offer a detailed electronic Instructor’s Manual, figure files, Microsoft® PowerPoint® presentations, and the Cognero Test Bank. The Instructor’s Manual includes suggestions and strategies for using this text, as well as answers to Review Questions and solutions to the end-of-chapter exercises. Figure files allow instructors to create their own presentations using figures appearing in the text. Instructors can also take advantage of lecture presentations provided on PowerPoint slides; these presentations follow each chapter’s coverage precisely, include chapter figures, and can be customized.

The Instructor’s Resources include copies of the databases for the TAL Distributors, Colonial Adventure Tours, and Solmaris Condominium Group cases in Microsoft Access 2010/2013 format and script files to create the tables and data in these databases in Oracle and SQL Server. These files are provided so instructors have the choice of assigning exercises in which students create the databases used in this text and load them with data, or they can provide the starting Access databases or Oracle or SQL Server script files to students to automate and simplify these tasks.

ORGANIZATION OF THE TEXT

The text contains eight chapters and three appendices, which are described in the following sections.

Chapter 1: Introduction to TAL Distributors, Colonial Adventure Tours, and Solmaris Condominium Group

Chapter 1 introduces the three database cases that are used throughout the text: TAL Distributors, Colonial Adventure Tours, and Solmaris Condominium Group. Many Q&A exercises are provided throughout the chapter to ensure that students understand how to manipulate the database on paper before they begin working in SQL.

Chapter 2: Database Design Fundamentals

Chapter 2 covers important concepts and terminology associated with relational databases, functional dependence, and primary keys, followed by a method for designing a database to satisfy a given set of requirements. It also illustrates the normalization process for finding and correcting a variety of potential problems in database designs. Finally, it shows how to represent database designs graphically using entity-relationship diagrams.

Chapter 3: Creating Tables

In Chapter 3, students begin using a DBMS by creating and running SQL commands to create tables, use data types, and add rows to tables. Chapter 3 also discusses the role of and use of nulls.

Chapter 4: Single-Table Queries

Chapter 4 is the first of two chapters on using SQL commands to query a database. The queries in Chapter 4 all involve single tables. Included in this chapter are discussions of simple and compound conditions; computed columns; the SQL BETWEEN, LIKE, and IN operators; using SQL aggregate functions; nesting queries; grouping data; and retrieving columns with null values.

Chapter 5: Multiple-Table Queries

Chapter 5 completes the discussion of querying a database by demonstrating queries that join more than one table. Included in this chapter are discussions of the SQL IN and EXISTS operators, nested subqueries, using aliases, joining a table to itself, SQL set operations, and the use of the ALL and ANY operators. The chapter also includes coverage of various types of joins.

Chapter 6: Updating Data

In Chapter 6, students learn how to use the SQL COMMIT, ROLLBACK, UPDATE, INSERT, and DELETE commands to update table data. Students also learn how to

create a new table from an existing table and how to change the structure of a table. The chapter also includes coverage of transactions, including both their purpose and implementation.

Chapter 7: Database Administration

Chapter 7 covers the database administration features of SQL, including the use of views; granting and revoking database privileges to users; creating, dropping, and using an index; using and obtaining information from the system catalog; and using integrity constraints to control data entry.

Chapter 8: SQL Functions and Procedures

Chapter 8 begins with a discussion of some important SQL functions that act on single rows. Students will also learn how to use PL/SQL and T-SQL to cover the process of embedding SQL commands in another language. Included in this chapter are discussions of using embedded SQL to insert new rows and change and delete existing rows. Also included is a discussion of how to retrieve single rows using embedded SQL commands and how to use cursors to retrieve multiple rows. Chapter 8 also includes a section showing some techniques for using SQL in Visual Basic (Access). The chapter concludes with a discussion of triggers.

Appendix A: SQL Reference

Appendix A includes a command reference for all the major SQL clauses and operators that are featured in the chapters. Students can use Appendix A as a quick resource when constructing commands. Each command includes a short description, a table that shows the required and optional clauses and operators, and an example and its results. It also contains a reference to the pages in the text where the command is covered.

Appendix B: How Do I Reference

Appendix B provides students with an opportunity to ask a question, such as “How do I delete rows?” and to identify the appropriate section in Appendix A to use to find the answer. Appendix B is extremely valuable when students know what task they want to accomplish but can’t remember the exact SQL command they need.

Appendix C: Answers to Odd-Numbered Review Questions

Answers to the odd-numbered Review Questions in each chapter appear in this appendix so students can make sure that they are completing the Review Questions correctly.

GENERAL NOTES TO THE STUDENT

1. You can download the databases used in this text from www.cengage.com. Use your browser to go to www.CengageBrain.com.

2. The first time you go to the site, you will need to register. It's free. Click on "Sign Up" in the top right corner of the page and fill out the registration information. (After you have signed in once, whenever you return to CengageBrain, you will enter the user name and password you have chosen and you will be taken directly to the companion site for your book.)
3. Once you have registered and logged in for the first time, go to the "Search for Books or Materials" bar and enter the author or ISBN for your textbook. When the title of your text appears, click on it and you will be taken to the companion site. There you can choose among the various folders provided on the Student side of the site. NOTE: If you are currently using more than one Cengage textbook, the same user name and password will give you access to all the companion sites for your Cengage titles. After you have entered the information for each title, all the titles you are using will appear listed in the pull-down menu in the "Search for Books or Materials" bar. Whenever you return to CengageBrain, you can click on the title of the site you wish to visit and go directly there.

The script files saved in the Oracle folder have the following functions:

OracleSolmaris.sql: Creates all the tables in the Solmaris Condominium Group database and adds all the data. Run this script file to create the Solmaris Condominium Group database. (*Note:* This script file assumes you have not previously created any of the tables in the database. If you have created any of the tables, you should run the OracleDropSolmaris.sql script prior to running the OracleSolmaris.sql script.)

OracleColonial.sql: Creates all the tables in the Colonial Adventure Tours database and adds all the data. Run this script file to create the Colonial Adventure Tours database. (*Note:* This script file assumes you have not previously created any of the tables in the database. If you have created any of the tables, you should run the OracleDropColonial.sql script prior to running the OracleColonial.sql script.)

OracleTAL.sql: Creates all the tables in the TAL Distributors database and adds all the data. Run this script file to create the TAL Distributors database. (*Note:* This script file assumes you have not previously created any of the tables in the database. If you have created any of the tables, you should run the OracleDropTAL.sql script prior to running the OracleTAL.sql script.)

OracleDropSolmaris.sql: Drops (deletes) all the tables and data in the Solmaris Condominium Group database.

OracleDropColonial.sql: Drops (deletes) all the tables and data in the Colonial Adventure Tours database.

OracleDropTAL.sql: Drops (deletes) all the tables and data in the TAL Distributors database.

The script files saved in the SQL Server folder have the following functions:

SQLServerSolmaris.sql: Creates all the tables in the Solmaris Condominium Group database and adds all the data. Run this script file to create the Solmaris Condominium Group database. (*Note:* This script file assumes you have not previously created any of the tables in the database. If you have created any of the tables, you should run the SQLServerDropSolmaris.sql script prior to running the SQLServerSolmaris.sql script.)

SQLServerColonial.sql: Creates all the tables in the Colonial Adventure Tours database and adds all the data. Run this script file to create the Colonial Adventure Tours database. (*Note:* This script file assumes you have not previously created any of the tables in the database. If you have created any of the tables, you should run the SQLServerDropColonial.sql script prior to running the SQLServerColonial.sql script.)

SQLServerTAL.sql: Creates all the tables in the TAL Distributors database and adds all the data. Run this script file to create the TAL Distributors database. (*Note:* This script file assumes you have not previously created any of the tables in the database. If you have created any of the tables, you should run the SQLServerDropTAL.sql script prior to running the SQLServerTAL.sql script.)

SQLServerDropSolmaris.sql: Drops (deletes) all the tables and data in the Solmaris Condominium Group database.

SQLServerDropColonial.sql: Drops (deletes) all the tables and data in the Colonial Adventure Tours database.

SQLServerDropTAL.sql: Drops (deletes) all the tables and data in the TAL Distributors database.

For details on running script files in Oracle or SQL Server, check with your instructor. You can also refer to Chapter 3 in the text for information about creating and using scripts.

For information about downloading the Oracle Database 11g Express Edition software, please visit the Oracle Web site. For information about SQL Server Express, please visit the Microsoft Web site. Information about Microsoft Access is also available at the Microsoft Web site.

Embedded Questions

In many places, you'll find Q&A sections to ensure that you understand some crucial material before you proceed. In some cases, the questions are designed to give you the chance to consider some special concept in advance of its actual presentation. In all cases, the answer to each question appears immediately after the question. You can simply read the question and its answer, but you will benefit from taking time to determine the answer to the question before checking your answer against the one given in the text.

End-of-Chapter Material

The end-of-chapter material consists of a Summary, a Key Terms list, Review Questions, and exercises for the TAL Distributors, Colonial Adventure Tours, and Solmaris Condominium Group databases. The Summary briefly describes the material covered in the chapter. The Review Questions require you to recall and apply the important material in the chapter. The answers to the odd-numbered Review Questions appear in Appendix C so you can check your progress. The TAL Distributors, Colonial Adventure Tours, and Solmaris Condominium Group exercises test your knowledge of the chapter material; your instructor will assign one or more of these exercises for you to complete. Critical-thinking questions that reinforce problem-solving and analytical skills are included for review questions and hands-on exercises.

A C K N O W L E D G M E N T S

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CHAPTER 1

INTRODUCTION TO TAL DISTRIBUTORS, COLONIAL ADVENTURE TOURS, AND SOLMARIS CONDOMINIUM GROUP

OBJECTIVES

- Introduce TAL Distributors, a company whose database is used as the basis for many of the examples throughout the text
- Introduce Colonial Adventure Tours, a company whose database is used as a case that runs throughout the text
- Introduce Solmaris Condominium Group, a company whose database is used as an additional case that runs throughout the text

INTRODUCTION

In this chapter, you will examine the database requirements of TAL Distributors, a company that will be used in the examples throughout the text. Then you will examine the database requirements for Colonial Adventure Tours and Solmaris Condominium Group, whose databases are featured in the exercises that appear at the end of each chapter.

WHAT IS A DATABASE?

Throughout this text, you will work with databases for three organizations: TAL Distributors, Colonial Adventure Tours, and Solmaris Condominium Group. A **database** is a structure that contains different categories of information and the relationships between these categories. The TAL Distributors database, for example, contains information about categories such as

sales representatives (sales reps), customers, orders, and items. The Colonial Adventure Tours database contains information about categories such as trips, guides, customers, and reservations. The Solmaris Condominium Group database contains information about categories such as condominiums, condo units, condo owners, service categories, and service requests.

Each database also contains relationships between categories. For example, the TAL Distributors database contains information that relates sales reps to the customers they represent and customers to the orders they have placed. The Colonial Adventure Tours database contains information that relates customers to the reservations they make and guides to the trips they lead. The Solmaris Condominium Group database contains information that relates the condo units in each condo location to their owners.

As you work through the chapters in this text, you will learn more about these databases and how to view and update the information they contain. As you read each chapter, you will see examples from the TAL Distributors database. At the end of each chapter, your instructor might assign the exercises for the TAL Distributors, Colonial Adventure Tours, or Solmaris Condominium Group databases.

THE TAL DISTRIBUTORS DATABASE

The management of TAL Distributors, a wholesaler of finely crafted wooden toys, games, and puzzles, has determined that the company's recent growth no longer makes it feasible to maintain customer, order, and inventory data using its manual systems. With the data stored in a database, management will be able to ensure that the data is up to date and more accurate than in the current manual systems. In addition, managers will be able to obtain answers to their questions concerning the data in the database easily and quickly, with the option of producing a variety of useful reports.

Management has determined that TAL Distributors must maintain the following information about its sales reps, customers, and inventory in the new database:

- The number, last name, first name, address, total commission, and commission rate for each sales rep
- The customer number, name, address, current balance, and credit limit for each customer, as well as the number of the sales rep who represents the customer
- The item number, description, number of units on hand, category, number of the storehouse where the item is stored, and unit price for each item in inventory

TAL Distributors also must store information about orders. Figure 1-1 shows a sample order.

ITEM NUMBER	DESCRIPTION	NUMBER ORDERED	PRICE	TOTAL
KL78	Pick Up Sticks	25	10.95	273.75
TR40	Tic Tac Toe	10	13.99	139.90
			Extensions	
TOTAL				413.65

TAL Distributors
 555 Main Street
 San Rita, TX 78364
 Phone (512) 555-0190 Fax (512) 555-0191

INVOICE
 ORDER: 51610
 DATE: October 12, 2015

TO:
 CUSTOMER: 334
 The Everything Shop
 342 Magee St.
 Congaree, CA 90097

SALES REP: 45
 Hui Tian

Make all checks payable to TAL Distributors
 Total due in 15 days. Overdue accounts subject to a service charge of 1% per month.

Thank you for your business!

FIGURE 1-1 Sample order

The sample order shown in Figure 1-1 has three sections:

- The heading (top) of the order contains the company name; the order number and date; the customer's number, name, and address; and the sales rep's number and name.
- The body of the order contains one or more order lines, sometimes called line items. Each order line contains an item number, an item description, the number of units of the item ordered, and the quoted price for the item. Each order line also contains a total, usually called an extension, which is the result of multiplying the number ordered by the quoted price.
- Finally, the footing (bottom) of the order contains the order total.

TAL Distributors also must store the following items in the database for each customer's order:

- For each order, the database must store the order number, the date the order was placed, and the number of the customer that placed the order. The customer's name and address and the number of the sales rep who represents the customer are stored with the customer information. The name of the sales rep is stored with the sales rep information.
- For each order, the database must store the order number, the item number, the number of units ordered, and the quoted price for each order line. The item description is stored with the information about items. The result of multiplying the number of units ordered by the quoted price is not stored because the database can calculate it when needed.

The overall order total is not stored. Instead, the database calculates the total whenever an order is printed or displayed on the screen.

Figure 1-2 shows sample data for TAL Distributors.

REP								
REP_NUM	LAST_NAME	FIRST_NAME	STREET	CITY	STATE	POSTAL_CODE	COMMISSION	RATE
15	Campos	Rafael	724 Vinca Dr.	Grove	CA	90092	\$23,457.50	0.06
30	Gradey	Megan	632 Liatris St.	Fullton	CA	90085	\$41,317.00	0.08
45	Tian	Hui	1785 Tyler Ave.	Northfield	CA	90098	\$27,789.25	0.06
60	Sefton	Janet	267 Oakley St.	Congaree	CA	90097	\$0.00	0.06

CUSTOMER								
CUSTOMER_NUM	CUSTOMER_NAME	STREET	CITY	STATE	POSTAL_CODE	BALANCE	CREDIT_LIMIT	REP_NUM
126	Toys Galore	28 Laketon St.	Fullton	CA	90085	\$1,210.25	\$7,500.00	15
260	Brookings Direct	452 Columbus Dr.	Grove	CA	90092	\$575.00	\$10,000.00	30
334	The Everything Shop	342 Magee St.	Congaree	CA	90097	\$2,345.75	\$7,500.00	45
386	Johnson's Department Store	124 Main St.	Northfield	CA	90098	\$879.25	\$7,500.00	30
440	Grove Historical Museum Store	3456 Central Ave.	Fullton	CA	90085	\$345.00	\$5,000.00	45
502	Cards and More	167 Hale St.	Mesa	CA	90104	\$5,025.75	\$5,000.00	15
586	Almondton General Store	3345 Devon Ave.	Almondton	CA	90125	\$3,456.75	\$15,000.00	45
665	Cricknet Gift Shop	372 Oxford St.	Grove	CA	90092	\$678.90	\$7,500.00	30
713	Cress Store	12 Rising Sun Ave.	Congaree	CA	90097	\$4,234.60	\$10,000.00	15
796	Unique Gifts	786 Passmore St.	Northfield	CA	90098	\$124.75	\$7,500.00	45
824	Kline's	945 Gilham St.	Mesa	CA	90104	\$2,475.99	\$15,000.00	30
893	All Season Gifts	382 Wildwood Ave.	Fullton	CA	90085	\$935.75	\$7,500.00	15

FIGURE 1-2 Sample data for TAL Distributors

ORDERS

ORDER_NUM	ORDER_DATE	CUSTOMER_NUM
51608	10/12/2015	126
51610	10/12/2015	334
51613	10/13/2015	386
51614	10/13/2015	260
51617	10/15/2015	586
51619	10/15/2015	126
51623	10/15/2015	586
51625	10/16/2015	796

ORDER_LINE

ORDER_NUM	ITEM_NUM	NUM_ORDERED	QUOTED_PRICE
51608	CD33	5	\$86.99
51610	KL78	25	\$10.95
51610	TR40	10	\$13.99
51613	DL51	5	\$104.95
51614	FD11	1	\$124.95
51617	NL89	4	\$115.99
51617	TW35	3	\$116.95
51619	FD11	2	\$121.95
51623	DR67	5	\$29.95
51623	FH24	12	\$36.95
51623	KD34	10	\$13.10
51625	MT03	8	\$45.79

ITEM

ITEM_NUM	DESCRIPTION	ON_HAND	CATEGORY	STOREHOUSE	PRICE
AH74	Patience	9	GME	3	\$22.99
BR23	Skittles	21	GME	2	\$29.99
CD33	Wood Block Set (48 piece)	36	TOY	1	\$89.49
DL51	Classic Railway Set	12	TOY	3	\$107.95
DR67	Giant Star Brain Teaser	24	PZL	2	\$31.95
DW23	Mancala	40	GME	3	\$50.00
FD11	Rocking Horse	8	TOY	3	\$124.95
FH24	Puzzle Gift Set	65	PZL	1	\$38.95
KA12	Cribbage Set	56	GME	3	\$75.00
KD34	Pentominoes Brain Teaser	60	PZL	2	\$14.95
KL78	Pick Up Sticks	110	GME	1	\$10.95
MT03	Zauberkasten Brain Teaser	45	PZL	1	\$45.79
NL89	Wood Block Set (62 piece)	32	TOY	3	\$119.75
TR40	Tic Tac Toe	75	GME	2	\$13.99
TW35	Fire Engine	30	TOY	2	\$118.95

FIGURE 1-2 Sample data for TAL Distributors (*continued*)

In the REP table, you see that there are four reps, whose numbers are 15, 30, 45, and 60. The name of sales rep 15 is Rafael Campos. His street address is 724 Vinca Dr. He lives in Grove, CA, and his postal code is 90092. His total commission is \$23,457.50, and his commission rate is 0.06 (six percent).

In the CUSTOMER table, 12 TAL Distributors customers are identified with the numbers 126, 260, 334, 386, 440, 502, 586, 665, 713, 796, 824, and 893. The name of customer number 126 is Toys Galore. This customer's address is 28 Laketon St. in Fullton, CA, with a postal code of 90085. The customer's current balance is \$1,210.25, and its credit limit is \$7,500.00. The number 15 in the REP_NUM column indicates that Toys Galore is represented by sales rep 15 (Rafael Campos).

Skipping to the table named ITEM, you see that there are 15 items, whose item numbers are AH74, BR23, CD33, DL51, DR67, DW23, FD11, FH24, KA12, KD34, KL78, MT03, NL89, TR40, and TW35. Item AH74 is Patience, and TAL Distributors has nine units of this item on hand. The Patience item is in the GME (games) category, and is located in storehouse 3. The price of the Patience game is \$22.99. Other categories are PZL (puzzles) and TOY (toys).

Moving back to the table named ORDERS, you see that there are eight orders, which are identified with the numbers 51608, 51610, 51613, 51614, 51617, 51619, 51623, and 51625. Order number 51608 was placed on October 12, 2015, by customer 126 (Toys Galore).

NOTE

In some database systems, the word *order* has a special purpose. Having a table named ORDER could cause problems in such systems. For this reason, TAL Distributors uses the table name ORDERS instead of ORDER.

The table named ORDER_LINE might seem strange at first glance. Why do you need a separate table for the order lines? Could they be included in the ORDERS table? The answer is technically yes. You could structure the table named ORDERS as shown in Figure 1-3. Notice that this table contains the same orders as shown in Figure 1-2, with the same dates and customer numbers. In addition, each table row in Figure 1-3 contains all the order lines for a given order. Examining the second row, for example, you see that order 51610 has two order lines. One of the order lines is for 25 units of item KL78 at \$10.95 each, and the other order line is for 10 units of item TR40 at \$13.99 each.

ORDERS

ORDER_NUM	ORDER_DATE	CUSTOMER_NUM	ITEM_NUM	NUM_ORDERED	QUOTED_PRICE
51608	10/12/2015	126	CD33	5	\$86.99
51610	10/12/2015	334	KL78	25	\$10.95
			TR40	10	\$13.99
51613	10/13/2015	386	DL51	5	\$104.95
51614	10/13/2015	260	FD11	1	\$124.95
51617	10/15/2015	586	NL89	4	\$115.99
			TW35	3	\$116.95
51619	10/15/2015	126	FD11	2	\$121.95
51623	10/15/2015	586	DR67	5	\$29.95
			FH24	12	\$36.95
			KD34	10	\$13.10
51625	10/16/2015	796	MT03	8	\$45.79

FIGURE 1-3 Alternative ORDERS table structure

Q & A

Question: How is the information from Figure 1-2 represented in Figure 1-3?

Answer: Examine the ORDER_LINE table shown in Figure 1-2 and note the second and third rows. The second row indicates that there is an order line on order 51610 for 25 units of item KL78 at \$10.95 each. The third row indicates that there is an order line on order 51610 for 10 units of item TR40 at \$13.99 each. Thus, the information that you find in Figure 1-3 is represented in Figure 1-2 in two separate rows rather than in one row.

It might seem inefficient to use two rows to store information that could be represented in one row. There is a problem, however, with the arrangement shown in Figure 1-3—the table is more complicated. In Figure 1-2, there is a single entry at each location in the table. In Figure 1-3, some of the individual positions within the table contain multiple entries, making it difficult to track the information between columns. In the row for order number 51610, for example, it is crucial to know that the KL78 corresponds to the 25 in the NUM_ORDERED column (not to the 10) and that it corresponds to the \$10.95 in the QUOTED_PRICE column (not to the \$13.99). In addition, a more complex table raises practical issues, such as:

- How much room do you allow for these multiple entries?
- What happens when an order has more order lines than you have allowed room for?
- For a given item, how do you determine which orders contain order lines for that item?

Although none of these problems is unsolvable, they do add a level of complexity that is not present in the arrangement shown in Figure 1-2. In Figure 1-2, there are no multiple entries to worry about, it does not matter how many order lines exist for any order, and finding every order that contains an order line for a given item is easy (just look for all order lines with the given item number in the ITEM_NUM column). In general, this simpler structure is preferable, and that is why order lines appear in a separate table.

To test your understanding of the TAL Distributors data, use Figure 1-2 to answer the following questions.

Q & A

Question: What are the numbers of the customers represented by Rafael Campos?

Answer: 126, 502, 713, and 893. (Look up the REP_NUM value of Rafael Campos in the REP table and obtain the number 15. Then find all customers in the CUSTOMER table that have the number 15 in the REP_NUM column.)

Q & A

Question: What is the name of the customer that placed order 51613, and what is the name of the rep who represents this customer?

Answer: Johnson's Department Store is the customer, and Megan Gradey is the rep. (Look up the CUSTOMER_NUM value in the ORDERS table for order number 51613 and obtain the number 386. Then find the customer in the CUSTOMER table with the CUSTOMER_NUM value of 386. Using the REP_NUM value, which is 30, find the name of the rep in the REP table.)

Q & A

Question: List all items that appear in order 51617. For each item, give the description, number ordered, and quoted price.

Answer: Item number: NL89; description: Wood Block Set (62 piece), number ordered: 4; and quoted price: \$115.99. Also, item number: TW35; description: Fire Engine; number ordered: 3; and quoted price: \$116.95. (Look up each ORDER_LINE table row on which the order number is 51617. Each of these rows contains an item number, the number ordered, and the quoted price. Use the item number to look up the corresponding item description in the ITEM table.)

Q & A

Question: Why is the QUOTED_PRICE column in the ORDER_LINE table? Can't you just use the item number and look up the price in the ITEM table?

Answer: If the QUOTED_PRICE column did not appear in the ORDER_LINE table, you would need to obtain the price for an item on an order line by looking up the price in the ITEM table. Although this approach is reasonable, it prevents TAL Distributors from charging different prices to different customers for the same item. Because TAL Distributors wants the flexibility to quote and charge different prices to different customers, the QUOTED_PRICE column is included in the ORDER_LINE table. If you examine the ORDER_LINE table, you will see cases in which the quoted price matches the actual price in the ITEM table and cases in which it differs. For example, in order number 51608, Toys Galore bought five Wood Block Sets (48 piece), and TAL Distributors charged only \$86.99 per set, and not the regular price of \$89.49.

THE COLONIAL ADVENTURE TOURS DATABASE

Colonial Adventure Tours is a small business that organizes day-long, guided trips to New England. Like the management of TAL Distributors, Colonial Adventure Tours has decided to store its data in a database. The company wants to achieve the same benefits; that is, it wants to ensure that its data is current and accurate. In addition, the management of

Colonial Adventure Tours wants to be able to ask questions concerning the data and to obtain answers to these questions easily and quickly.

In running the guided tours, management gathers and organizes information about guides, trips, customers, and reservations. Figure 1-4 shows sample guide data for Colonial Adventure Tours. Each guide has a number that uniquely identifies the guide. In addition, Colonial Adventure Tours records the guide's last name, first name, address, city, state, postal code, telephone number, and hire date.

GUIDE

GUIDE_NUM	LAST_NAME	FIRST_NAME	ADDRESS	CITY	STATE	POSTAL_CODE	PHONE_NUM	HIRE_DATE
AM01	Abrams	Miles	54 Quest Ave.	Williamsburg	MA	01096	617-555-6032	6/3/2012
BR01	Boyers	Rita	140 Oakton Rd.	Jaffrey	NH	03452	603-555-2134	3/4/2012
DH01	Devon	Harley	25 Old Ranch Rd.	Sunderland	MA	01375	781-555-7767	1/8/2012
GZ01	Gregory	Zach	7 Moose Head Rd.	Dummer	NH	03588	603-555-8765	11/4/2012
KS01	Kiley	Susan	943 Oakton Rd.	Jaffrey	NH	03452	603-555-1230	4/8/2013
KS02	Kelly	Sam	9 Congaree Ave.	Fraconia	NH	03580	603-555-0003	6/10/2013
MR01	Marston	Ray	24 Shenandoah Rd.	Springfield	MA	01101	781-555-2323	9/14/2015
RH01	Rowan	Hal	12 Heather Rd.	Mount Desert	ME	04660	207-555-9009	6/2/2014
SL01	Stevens	Lori	15 Riverton Rd.	Coventry	VT	05825	802-555-3339	9/5/2014
UG01	Unser	Glory	342 Pineview St.	Danbury	CT	06810	203-555-8534	2/2/2015

FIGURE 1-4 Sample guide data for Colonial Adventure Tours

Figure 1-5 shows sample trip data for Colonial Adventure Tours. Each trip has a number that uniquely identifies the trip. In addition, management tracks the trip name, the trip's starting location, the state in which the trip originates, the trip's total distance (in miles), the trip's maximum group size, the trip's type, and the trip's season.