

Putting Oracle SQL to Work

2nd Edition
Covers Oracle Database 10g



Mastering Oracle SQL



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Sanjay Mishra & Alan Beaulieu

Mastering Oracle SQL



SQL is the key to getting work done with the Oracle database. This is true whether you are a database administrator or a developer. Yet few bother to master SQL as they should, and fewer still take the time to become intimately acquainted with the richness of SQL functionality that Oracle provides, which goes well beyond what many competing database vendors provide.

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SECOND EDITION

Mastering Oracle SQL

Sanjay Mishra and Alan Beaulieu

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Mastering Oracle SQL, Second Edition

by Sanjay Mishra and Alan Beaulieu

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*I dedicate this book to my father.
I wish he were alive to see this book.*

—Sanjay Mishra

To my daughters, Michelle and Nicole.

—Alan Beaulieu

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Preface

SQL is the language for accessing a relational database. SQL provides a set of statements for storing and retrieving data to and from a relational database. It has gained steadily in popularity ever since the first relational database was unleashed upon the world. Other languages have been put forth, but SQL is now accepted as the standard language for almost all relational database implementations, including Oracle.

SQL is different from other programming languages because it is nonprocedural. Unlike programs in other languages, where you specify the sequence of steps to be performed, a SQL program (more appropriately called a SQL statement) only expresses the desired result. The responsibility for determining how the data will be processed to generate the desired result is left to the database management system. The nonprocedural nature of SQL makes it easier to access data in application programs.

If you are using an Oracle database, SQL is the interface you use to access the data stored in your database. SQL allows you to create database structures such as tables (to store your data), views, and indexes. SQL allows you to insert data into the database, and to retrieve that stored data in a desired format (for example, you might sort it). Finally, SQL allows you to modify, delete, and otherwise manipulate your stored data. SQL is the key to everything you do with the database. It's important to know how to get the most out of that interface. Mastery over the SQL language is one of the most vital requirements of a database developer or database administrator.

Why We Wrote This Book

Our motivation for writing this book stems from our own experiences learning how to use the Oracle database and Oracle's implementation of the SQL language. Oracle's SQL documentation consists of a reference manual that doesn't go into details about the practical usefulness of the various SQL features that Oracle supports. Nor does the manual present complex, real-life examples.

When we looked for help with SQL in the computer book market, we found that there are really two types of SQL books available. Most are the reference type that describe features and syntax, but that don't tell you how to apply that knowledge to real-life problems. The other type of book, very few-in-number, discusses the application of SQL in a dry and theoretical style without using any particular vendor's implementation. Since every database vendor implements their own variation of SQL, we find books based on "standard" SQL to be of limited usefulness.

In writing this book, we decided to write a practical book focused squarely on Oracle's version of SQL. Oracle is the market-leading database, and it's also the database on which we've honed our SQL expertise. In this book, we not only cover the most important and useful of Oracle's SQL features, but we show ways to apply them to solve specific problems.

What's New in Oracle SQL?

When we wrote the first edition of this book, Oracle9i had just come out, and we managed to cover some of the interesting and new features in that release of the database. Now, Oracle Database 10g has just been released, and there are even more new features to talk about:

- A new, MODEL clause has been added to the SELECT statement, enabling you to write queries that perform spreadsheet-like calculations against multidimensional arrays created from data you select from the database.
- Oracle has added support for using regular expressions from SQL, and with a vengeance. Not only can you use regular expressions to select data, but also to manipulate data in various, useful ways. For example, you can perform regular expression search-and-replace operations. No other database vendor that we know of offers such powerful, regular expression functionality.
- XML is everywhere these days, and that hasn't gone unnoticed in the world of SQL. The ANSI/ISO folk have created the SQL/XML standard, which defines mechanisms for selecting relational data and presenting it in XML form. Oracle supports this standard, which involves several, new SQL functions. Oracle also now supports XML as a native data type.

These are just the big features, which, of course, we cover in this second edition. In addition, we cover many small updates to Oracle SQL, such as the multiset union operators that enable you to perform set operations involving nested table collections.

Finally, we've worked carefully together as a team, not only with each other, but also with our editor, to ensure that all examples in this book are drawn from a single data set. You'll be able to download that data set from this book's catalog page. You can then use it to follow along with our examples.

Objectives of This Book

The single most important objective of this book is to help you harness the power of Oracle SQL to the maximum extent possible. You will learn to:

- Understand the features and capabilities of the SQL language, as implemented by Oracle.
- Use complex SQL features, such as outer joins, correlated subqueries, hierarchical queries, grouping operations, and analytical queries.
- Use DECODE and CASE to implement conditional logic in your SQL queries.
- Write SQL statements that operate against partitions, objects, and collections, such as nested tables and variable arrays.
- Use the new SQL features introduced in Oracle Database 10g, such as regular expressions and interrow calculations.
- Use best-practices to write efficient, maintainable SQL queries.

One topic that is important to us and many of our readers, but which is not explicitly discussed in this book is SQL tuning. Tuning tips are sprinkled throughout the book, but we do not include a chapter on tuning for the following reasons:

- Tuning is a large topic, and reasonable coverage of SQL tuning would easily double or triple the size of this book.
- There are already many excellent Oracle-specific and general-purpose tuning books on the market, whereas there are very few books (in our opinion, exactly one) that thoroughly explore the feature set of Oracle SQL.
- In many ways, mastery of Oracle's SQL implementation is the most important tool in your tuning toolkit.

With this book under your belt, you will be less likely to write SQL statements that perform badly, and you will be able to employ multiple strategies to rework existing statements.

Audience for This Book

This book is for Oracle developers, database administrators, and anyone who needs access to data stored in an Oracle database for reporting or ad-hoc analysis. Whether you are new to the world of databases or a seasoned professional, if you use SQL to access an Oracle database, this book is for you. Whether you use simple queries to access data or embed them in PL/SQL or Java programs, SQL is the core of all data access tasks in your application. Knowing the power and flexibility of SQL will improve your productivity, allowing you to get more done in less time, and with increased certainty that the SQL statements you write are indeed correct.

Platform and Version

We used Oracle Database 10g in writing this book. We've covered many of Oracle Database 10g's important new SQL features, including regular expressions, hierarchical query features, object and collection functionality, and interrow calculations. Most of the concepts, syntax, and examples apply to earlier releases of Oracle as well. We specifically point out the new Oracle Database 10g features.

Structure of This Book

This book is divided into 18 chapters and 1 appendix:

- Chapter 1, *Introduction to SQL*, introduces the SQL language and describes its brief history. This chapter is primarily for those readers who have little or no prior SQL experience. You'll find simple examples of the core SQL statements (SELECT, INSERT, UPDATE, and DELETE) and of SQL's basic features.
- Chapter 2, *The WHERE Clause*, describes ways to filter data in your SQL statements. You'll learn to restrict the results of a query to the rows you wish to see, and restrict the results of a data manipulation statement to the rows you wish to modify.
- Chapter 3, *Joins*, describes constructs used to access data from multiple, related tables. The important concepts of inner join and outer join are discussed in this chapter.
- Chapter 4, *Group Operations*, shows you how to generate summary information, such as totals and subtotals, from your data. Learn how to define groups of rows, and how to apply various aggregate functions to summarize data in those groups.
- Chapter 5, *Subqueries*, shows you how to use correlated and noncorrelated subqueries and inline views to solve complex problems that would otherwise require procedural code together with more than one query.
- Chapter 6, *Handling Temporal Data*, talks about handling date and time information in an Oracle database. Learn the tricks and traps of querying time-based data.
- Chapter 7, *Set Operations*, shows you how to use UNION, INTERSECT, and MINUS to combine results from two or more independent component queries into one.
- Chapter 8, *Hierarchical Queries*, shows you how to store and extract hierarchical information (such as in an organizational chart) from a relational table. Oracle provides many features to facilitate working with hierarchical data, including several new features introduced in Oracle Database 10g.

-
- Chapter 9, *DECODE and CASE*, talks about two very powerful yet simple features of Oracle SQL that enable you to simulate conditional logic in what is otherwise a declarative language.
 - Chapter 10, *Partitioning*, discusses the issues involved with creating and accessing partitioned tables using SQL. Learn to write SQL statements that operate on specific partitions and subpartitions.
 - Chapter 11, *PL/SQL*, explores the integration of SQL and PL/SQL. This chapter describes how to call PL/SQL stored procedures and functions from SQL statements, and how to write efficient SQL statements within PL/SQL programs.
 - Chapter 12, *Objects and Collections*, explores the object-oriented aspects of the Oracle database server, including object types and collections.
 - Chapter 13, *Advanced Group Operations*, deals with complex grouping operations used mostly in decision support systems. We show you how to use Oracle features such as ROLLUP, CUBE, and GROUPING SETS to efficiently generate various levels of summary information required by decision-support applications. We also discuss the grouping features that enable composite and concatenated groupings, including the GROUP_ID and GROUPING_ID functions.
 - Chapter 14, *Advanced Analytic SQL*, deals with analytical queries and analytic functions. Learn how to use ranking, windowing, and reporting functions to generate decision-support information.
 - Chapter 15, *SQL Best Practices*, talks about best practices that you should follow to write efficient and maintainable queries. Learn which SQL constructs are the most efficient for a given situation. For example, we describe when it's better to use WHERE instead of HAVING to restrict query results. We also discuss the performance implications of using bind variables vis-à-vis literal SQL.
 - Chapter 16, *XML*, explores how the Oracle server can store XML documents, features used to navigate, search, and extract content from XML documents, and functions used to generate XML documents from ordinary tables.
 - Chapter 17, *Regular Expressions*, shows how to write and interpret regular expressions for performing advanced text searches and substitutions.
 - Chapter 18, *Model Queries*, introduces the new, MODEL clause, which lets you manipulate relational data as if it were a big, multidimensional, spreadsheet (Oracle prefers the term *model*). Model queries enable you to solve problems using a single SQL statement that previously would have required you to download data to a third-party, spreadsheet program such as Microsoft Excel.
 - The Appendix, *Oracle's Old Join Syntax*, describes the SQL89 join syntax, and Oracle's proprietary, outer-join syntax. Only this syntax was available for joins until the release of Oracle9i Database, which introduced support for the newer, and better, SQL92 join syntax.

Conventions Used in This Book

The following typographical conventions are used in this book:

Italic

Used for filenames, directory names, table names, field names, and URLs. It is also used for emphasis and for the first use of a technical term.

Constant width

Used for examples and to show the contents of files and the output of commands. Also used for column names, XML element names, regular expressions, SQL literals mentioned in the text, and function names.

Constant width italic

Used in syntax descriptions to indicate user-defined items.

Constant width bold

Indicates user input in examples showing an interaction. Also indicates emphasized code elements to which you should pay particular attention.

Constant width bold italic

Used in code examples to emphasize aspects of the SQL statements, or results, that are under discussion.

UPPERCASE

In syntax descriptions, indicates keywords.

lowercase

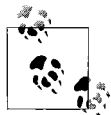
In syntax descriptions, indicates user-defined items, such as variables.

[] In syntax descriptions, square brackets enclose optional items.

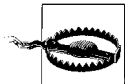
{ } In syntax descriptions, curly brackets enclose a set of items from which you must choose only one.

| In syntax descriptions, a vertical bar separates the items enclosed in curly or square brackets, as in {TRUE | FALSE}.

... In syntax descriptions, ellipses indicate repeating elements.



Indicates a tip, suggestion, or general note. For example, we use notes to point you to useful new features in Oracle Database 10g.



Indicates a warning or caution. For example, we'll tell you if a certain SQL clause might have unintended consequences if not used carefully.

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From Sanjay

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My adventure with Oracle's database started in the Tribology Workbench project at Tata Steel, Jamshedpur, India. Sincere thanks to my co-workers in the Tribology Workbench project for all the experiments and explorations we did during our learning days with Oracle. Ever since, Oracle database technology has become a way of life for me.

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From Alan

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Most of all, I would like to thank my wife, Nancy, for her support, patience, and encouragement, and my daughters, Michelle and Nicole, for their love and inspiration.

Introduction to SQL

In this introductory chapter, we explore the origin and utility of the SQL language, demonstrate some of the more useful features of the language, and define a simple database design from which most examples in the book are derived.

What Is SQL?

SQL is a special-purpose language used to define, access, and manipulate data. SQL is *nonprocedural*, meaning that it describes the necessary components (i.e., tables) and desired results without dictating exactly how those results should be computed. Every SQL implementation sits atop a *database engine*, whose job it is to interpret SQL statements and determine how the various data structures in the database should be accessed to accurately and efficiently produce the desired outcome.

The SQL language includes two distinct sets of commands: *Data Definition Language* (DDL) is the subset of SQL used to define and modify various data structures, while *Data Manipulation Language* (DML) is the subset of SQL used to access and manipulate data contained within the data structures previously defined via DDL. DDL includes numerous commands for handling such tasks as creating tables, indexes, views, and constraints, while DML is comprised of just five statements:

INSERT

Adds data to a database.

UPDATE

Modifies data in a database.

DELETE

Removes data from a database.

MERGE

Adds and/or modifies data in a database. MERGE is part of the 2003 ANSI SQL standard.

SELECT

Retrieves data from a database.

Some people feel that DDL is the sole property of database administrators, while database developers are responsible for writing DML statements, but the two are not so easily separated. It is difficult to efficiently access and manipulate data without an understanding of what data structures are available and how they are related; likewise, it is difficult to design appropriate data structures without knowledge of how the data will be accessed. That being said, this book deals almost exclusively with DML, except where DDL is presented to set the stage for one or more DML examples. The reasons for focusing on just the DML portion of SQL include:

- DDL is well represented in various books on database design and administration as well as in SQL reference guides.
- Most database performance issues are the result of inefficient DML statements.
- Even with a paltry five statements, DML is a rich enough topic to warrant not just one book, but a whole series of books.



Anyone who writes SQL in an Oracle environment should be armed with the following three books: a reference guide to the SQL language, such as *Oracle in a Nutshell* (O'Reilly); a performance-tuning guide, such as *Optimizing Oracle Performance* (O'Reilly); and the book you are holding, which shows how to best utilize and combine the various features of Oracle's SQL implementation.

So why should you care about SQL? In this age of Internet computing and n-tier architectures, does anyone even care about data access anymore? Actually, efficient storage and retrieval of information is more important than ever:

- Many companies now offer services via the Internet. During peak hours, these services may need to handle thousands of concurrent requests, and unacceptable response times equate to lost revenue. For such systems, every SQL statement must be carefully crafted to ensure acceptable performance as data volumes increase.
- We can store a lot more data today than we could just a few years ago. A single disk array can hold tens of terabytes of data, and the ability to store hundreds of terabytes is just around the corner. Software used to load or analyze data in these environments must harness the full power of SQL to process ever-increasing data volumes within constant (or shrinking) time windows.

Hopefully, you now have an appreciation for what SQL is and why it is important. The next section will explore the origins of the SQL language and the support for the SQL standard in Oracle's products.

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